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A DESCRIPTIVE AND ILLUSTRATED

CATALOGUE

OF THE

CALCULI

AND OTHER

ANIMAL CONCRETIONS

CONTAINED IN

THE MUSEUM

OF

THE ROYAL COLLEGE OF SURGEONS

IN LONDON.

(2.–3. part)

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ERRATA.

For partium, p. 145, third line from the bottom, *read* partum.
For Beliphaein, p. 163, *read* Biliphaein.

Division II.

CALCULI FROM THE URINARY ORGANS OF THE LOWER ANIMALS.

INTRODUCTION.

Calculous concretions are much less frequently found in the urinary organs of the lower animals than in those of Man. The composition of these bodies in the inferior animals is also much simpler, both as regards the number of layers of which they consist, and the chemical nature of their constituents. They very rarely contain those complex organic principles which constitute the greater part of the concretions from the human subject, as uric acid, urate of ammonia, and oxalic acid, but are generally composed of inorganic compounds, as the earthy carbonates and phosphates. Even among the latter class of substances the carbonates are of much more frequent occurrence than the phosphates.

Another peculiarity belonging to calculi from the lower animals is to be found in the fact, that they almost invariably consist of the same substance throughout; they sometimes vary in structure and appearance, but scarcely, if ever, possess the *alternating* structure so frequently observed in human urinary concretions. The only approach to an alternating calculus in this collection is from the Hog, in which phosphate of magnesia and ammonia has been deposited upon a small nucleus of carbonate of lime.

Domestic animals, especially the Horse, the Dog and the Ox, appear to be most subject to calculous disease. It must not, however, be inferred from this

circumstance that the formation of a calculus is solely produced by confinement, or the habits consequent upon domestication, since calculi are found in the urinary organs of the Whale, Iguana, Sturgeon and other animals living in a state of nature. It is also to be remembered that it is chiefly among domestic animals that we have the opportunity of discovering these bodies.

The composition of urinary calculi from the different species of animals appears to depend principally upon the nature of the food of the animal, and to be wholly irrespective of the class or division in the animal kingdom to which it may belong. In the carnivorous and omnivorous tribes, as the Dog, Whale, Eagle, Iguana and Sturgeon, we find calculi consisting of uric acid and of earthy phosphates, while the concretions from purely graminivorous animals are composed almost entirely of the carbonates of lime and magnesia.

This difference in composition probably depends upon a corresponding difference in the chemical characters of the healthy urine of these animals. In the Carnivora the urine is almost always acid, while in the Graminivora, from the presence of alkaline carbonates, it has invariably an alkaline reaction*.

The following Table is designed to illustrate the preceding remarks. It has been formed only from calculi, the origin of which is well authenticated. The figures indicate the number of specimens in the Museum from each animal.

Uric acid and the urates	From the Ostrich 1, Iguana 2.	
Oxalate of lime	„	Ox 2.
Phosphate of lime	„	Sturgeon 2.
Phosphate of magnesia and ammonia	„	Dog 3, Hog 1, Whale 1.
Mixed phosphates	„	Dog 2, Monkey 1.
Carbonate of lime, either pure or mixed with some carbonate of magnesia	„	Horse 8, Ass 1, Ox 10, Hog 4, Elephant 1, Rhinoceros 1, Tortoise 1.

Urinary calculi from the lower animals may be divided into the seven following classes or species:—1st, calculi consisting principally of uric acid, or of any

* Prof. Liebig has set forth some ingenious views as to the cause of the acidity and alkalinity of the urine, which it may be well to notice in this place. Assuming as an irrefutable fact, that the inorganic bases in the urine, such as potass, soda, lime, &c., have entered the organism through the medium of the elements, he has endeavoured to show that the acid or alkaline condition of the urine depends upon the nature of the inorganic constituents of the food of the animal, and is wholly uninfluenced by any difference in the processes of respiration, digestion or secretion. The ashes of all vegetable substances,

of its compounds, as the alkaline and earthy urates; 2nd, of oxalate of lime; 3rd, of cystic oxide; 4th, of phosphate of lime; 5th, of phosphate of magnesia and ammonia; 6th, of the fusible calculus, or the mixed phosphates; and lastly, of the carbonates of lime and magnesia.

Small and unimportant quantities of carbonate of magnesia, sulphate of lime, peroxide of iron, silica and alkaline salts, are frequently met with in the analysis of these concretions. They also contain a considerable quantity of animal matter, which is left undissolved in the form of thin membranous flakes, when the other constituents of the calculus are removed by the action of an acid or other solvent. The animal matter frequently retains the exact figure and size of the calculus in the same manner as the gelatine of bones.

The nature of the animal matter found in all species of calculi has never yet been satisfactorily determined. Some have regarded it as consisting of gelatine, others of albumen. Fourcroy believed that it was not always the same, but that it varied according to the nature of the calculus, being sometimes of an albuminous, sometimes of a gelatinous nature, and at others partaking of the characters of both*. Berzelius denies the possibility of determining its composition by chemical means†. In a great number of the calculi in this collection the animal matter has certainly been of an albuminous nature, nor could the existence of gelatine be satisfactorily detected. At the present time the almost universal opinion is, that the animal matter is an *accidental* constituent of the calculus, consisting chiefly of mucus, which has become entangled among the precipitating particles of the calculus, and has served to cement them mechanically into a solid mass.

If this view of the composition of the animal matter were correct, we should

with the exception of the seeds of the cereals and of leguminous plants, he states to be alkaline, owing to the presence of the carbonates of soda and potass, which either exist as such in the plant, or are derived from the decomposition of the vegetable acid with which the base was combined in the plant. Hence in graminivorous animals the urine cannot obtain an acid reaction, as the acids of the urine are supersaturated by the alkaline salts contained in the food. The ashes of muscular fibre, on the other hand, and also of the seeds of the cereals and leguminous plants, do not contain carbonated alkali, but abound in alkaline and earthy phosphates. According to Prof. Liebig, the acid character of the urine is produced by the reaction of uric, hippuric, and probably also of sulphuric acid upon these alkaline phosphates, by which part of the base of these salts is abstracted and an acidulous phosphate produced.

* *Système des Connaissances Chimiques*, tom. x. † *Lehrbuch der Chemie.*

expect to find it to consist of a mass of epithelial particles more or less closely matted together. Such is not, however, the case. In all species of urinary as well as intestinal concretions, the animal matter consists of a fine membranous tissue, which is uniformly diffused throughout the calculus, and varies slightly in appearance, according to the structure of the calculus. In calculi which have a laminated texture, it consists of concentric layers of a thin transparent structureless membrane, which presents a sharp and well-defined margin; sometimes the membrane is less homogeneous, and presents a granular appearance. In calculi which have a compact and crystalline texture, the animal matter does not admit of being separated into layers, but forms a continuous tissue. Small filaments, apparently possessing a tubular structure, are also sometimes to be observed: these filaments give off branches and occasionally ramify in every direction, so as to form a confused network; they vary in diameter from $\frac{1}{10,000}$ to $\frac{1}{30,000}$ of an inch*, but are not quite uniform, being sometimes irregularly dilated and occasionally presenting a moniliform appearance: they are apparently filled with a gelatinous or granular matter; in general they terminate abruptly, and occasionally have a small bulbous expansion at their extremities.

These filaments are most frequently found in intestinal concretions: they are apparently of a confervoid nature, and in urinary concretions it is most probable that they were formed after the calculus was taken from the body, and that they are of the nature of a vegetable mould. Portions of these filaments were, however, detected in some fragments of a phosphatic concretion which had been very recently taken from a patient, also in a urinary? calculus which had been preserved in spirit. In the phosphatic concretion just mentioned, numerous small globules were also observed by Mr. Quekett, which he supposed to be sporules. In the animal matter of urinary concretions, small irregular tubes are sometimes found which closely resemble those described in the animal matter of shell and coral. Epithelial scales, mucous globules, and portions of tissue similar to those which may be observed floating in the urine of persons labouring under calculous disease, are sometimes to be observed in the animal matter. Their presence is, however, by no means constant, and the purer the calculus the rarer do they become; they are most commonly met with in submaxillary calculi, and in

* As determined by J. S. Bowerbank, Esq., F.R.S.

urinary concretions consisting of the mixed phosphates*. The constant presence of animal matter in these concretions, and the uniform manner in which it is diffused throughout their substance, would render it probable that it is an *essential* constituent†.

The calculi in this collection are classified according to their chemical composition, and are marked by letters and numbers in a similar manner to that adopted with the human urinary concretions. A large number are without any history, and several are ascribed to animals in which it is scarcely possible that they could have occurred. In the following Table all the calculi in the collection from the lower animals are included, and a point of interrogation (?) is affixed to those whose assigned origin is doubtful.

	Uric acid and urates.	Oxalate of lime.	Phosphate of lime.	Phosphate of magnesia and ammonia.	Mixed phosphates.	Carbonate of lime and magnesia.
Monkey (*Simia*)	....		....	....	1	
Dog (*Canis familiaris*) . .	....		....	3	3	
Rat (*Mus decumanus*) . .						
Rabbit (*Lepus cuniculus*) .	....		1?			
Hog (*Sus scrofa*)	....		....	1	1	5
Horse (*Equus caballus*) . .	....		....	....	1?	16
Ass (*Equus asinus*) . . .	....		....	....	....	1
Ox (*Bos taurus*)	....	2	....	....	1?	11
Sheep (*Ovis ammon*) . . .	1?					
Elephant (*Elephas Indicus*) .	....		....	....	....	1
Whale	....		....	1		
Eagle (*Aquila*)						
Ostrich (*Struthio camelus*) .	1					
Fowl (*Phasianus gallus*) . .						
Tortoise (*Testudo*) . . .	....		....	....	....	1
Iguana (*Iguana tuberculata*)	3					
Sturgeon (*Acipenser sturio*)	....		2			

From the above Table we learn that graminivorous animals are most liable to calculous disease, and also that the greater number of calculi from the lower animals consist of carbonate of lime.

* The above-mentioned facts, with regard to the animal matter, were not observed until the first part of the Catalogue had been published. Although the subject is still under examination, and the nature of the tubular bodies cannot be regarded as decided, it has been considered advisable to give a general account of them in this place.

† The idea that calculi possess an organized structure is by no means new, and has been advocated by several authors, especially by Walther, who has endeavoured to show that urinary sediments and calculi are formed in a totally different manner.—*Journal der Chirurgie*, B. i. S. 189 *et seq.*

CALCULI CONSISTING OF URIC ACID AND ITS COMPOUNDS.

These substances, which form so large a proportion of the calculi from the urinary organs of Man, are very rarely found in those of the lower animals. The only specimens of this description in the Museum are from the Ostrich, from a species of Iguana, and from the Sheep. With regard to the calculus from the Sheep, it is exceedingly doubtful whether it was actually taken from that animal, although it has been retained in this place on the authority of the MS. Catalogue. Crystals of uric acid were found in a calculus from the Whale, and were apparently deposited between the layers of triple phosphate of which the bulk of the calculus consisted.

One of the most interesting facts that has arisen from the examination of this Collection, has been the discovery of three calculi composed principally of urate of potass. Two of these calculi are stated to have been taken from the bladder of the Iguana ; the third is without any history, but agrees with the other two both in chemical composition, structure and general appearance, although it is much larger. These concretions are of an oval shape, one side being considerably flattened so as to give their transverse section a pyriform figure. Their structure is laminar, except at the centre, where it is loose and granular. They are of a dirty white colour ; in their general appearance they resemble phosphatic concretions, and were described as such in the MS. Catalogue. Vide p. 142, Plate XIII. figs. 8, 9.

Uric acid concretions appear to have been met with most frequently in the Dog. Lassaigne analysed a calculus taken from that animal by M. Gerard, the Director of the Royal Veterinary School at Paris, which contained 58 per cent. of uric acid in combination with ammonia* ; and another specimen derived from an equally authentic source consisted almost entirely of sub-urate of ammonia†.

* *Journ. de Chém. Méd.*, tom. iv. p. 361. Lassaigne states that this calculus contained 30·8 per cent. of ammonia ; a quantity which, as is observed by L. Gmelin, *Handbuch der Chemie,* is incredible. The ammonia not having been estimated directly, it is most probable that both animal matter and water are included in this estimate.

† *Annales de Chimie,* tom. ix. p. 324.

Uric Acid.

P 1. Some small masses of a loosely cohering and readily friable deposit which were found in the bladder of an Ostrich.

Uric acid mixed with animal matter and traces of urate of ammonia and phosphate of lime; some colouring matter is also present, which, although rendered of a green colour by muriatic acid, differs from the colouring matter of the bile. *Hunterian.*

Urate of Ammonia.

P 2. A section of a small calculus composed of urate of ammonia. This calculus is said to have been taken from the kidney of a Sheep. "The kidney was greatly enlarged and its substance very tender and brittle." *Hunterian.*

P 3. Some small masses of uric acid and urate of ammonia, which were "found in the rectum of a Fowl." *Hunterian.*

P 4. Ditto. From the rectum of an Eagle. *Hunterian.*

P 5. Dried masses of the semifluid urine of the Boa Constrictor. This substance consists principally of suburate of ammonia.

Presented by W. Clift, Esq.

Urate of Potass.

The following calculi are the only instances that have been hitherto discovered of uric acid in combination with potass. They bear a striking resemblance to each other in their structure and general appearance, and have been doubtless taken from the urinary bladder of some of the species of Iguana that are found in South America.

P 6. A calculus of a flattened oval figure, described in the Sloanian MS. Catalogue as "Piedra de Yguana. From Mr. Houston, from Cartagena in America." It was accompanied by a description, in very bad Spanish, of its virtues as a remedy for the stone and gravel, with the mode of using it. It is composed of urate of potass mixed with urate of ammo-

nia and urate of lime, and gave the following results by analysis (Vide Plate XIII, fig. 9) :—

Uric acid with a trace of oxalate of lime . . .	78·64
Potass	10·42
Ammonia	3·10
Lime	1·89
Phosphate of lime	0·32
Water	1·67
Animal matter	2·73
	98·77

British Museum.

P 7. A small calculus consisting of urate of potass, which resembles the former specimen in general appearance, but is rather more dense. It had the following memorandum in the Sloanian MS. Catalogue :—" Esta piedra de Yguana servi para el mal d'Orina. From Mr. Houston, from Cartagena in America." *British Museum.*

P 8. This calculus was placed by Mr. Hunter among the human urinary concretions, but as it only differs in size from the two last described specimens, it is most probable that it has also a similar origin. It measures two inches and a quarter in length by two inches across, and is of an oval figure, having one of its sides flattened; when submitted to analysis its constituents were found to be as follows :—

Uric acid mixed with a trace of oxalate of lime.	78·36
Potass	13·19
Ammonia.	3·09
Lime	1·49
Magnesia	0·29
Phosphate of lime	0·02
Animal matter	1·80
Water	0·43
Sulphate of soda with chloride of sodium . .	traces
	98·67

Hunterian.

CALCULI CONSISTING PRINCIPALLY OF OXALATE OF LIME.

Oxalate of lime is most frequently found in calculi consisting chiefly of carbonate of lime, especially in those taken from the Horse. It may often be observed scattered over the surface of these concretions in the form of minute transparent octohedral crystals.

As forming the principal constituent of a calculus, oxalate of lime is of rare occurrence; the only specimens of this description in the Museum were taken from the ureter of the Hog, and one of them is figured in Plate XIII. Lassaigne detected 53 per cent. of this salt mixed with phosphate of lime and animal matter in some small calculi from the urethra of a Dog*; and according to Fourcroy and Vauquelin, it is also found in the urinary concretions of Rats†.

Q. *Oxalate of Lime.*

Q 1. A small tuberculated calculus consisting of oxalate of lime. "Taken out of the ureter of a Hog."—*Sloanian MS. Catalogue.*

British Museum, 1809.

Q 2. A similar concretion, also consisting of oxalate of lime, taken from the ureter of a Hog. "Given me by Mr. Morton, Northamptonshire."—*Sloanian MS. Catalogue.* *British Museum.*

CALCULI CONSISTING OF CYSTIC OXIDE.—CYSTINE.

Lassaigne has described a calculus from the bladder of a Dog which possessed the general chemical characters of cystic oxide. Its elementary composition, however, as determined by Lassaigne, is so entirely different, that considerable doubt must be entertained as to its identity with the cystic oxide of Wollaston‡.

CALCULI CONSISTING OF URIC OXIDE.—XANTHIC OXIDE.

Until very recently this substance had been only found in urinary calculi from Man. In a communication to the Academy of Sciences at Berlin, Prof. Magnus announced that uric oxide had been detected by M. Unger in guano, the decomposed excrement of sea-birds§.

* *Journ. de Chim. Méd.* tom. v. p. 633.

† Gmelin, *Handbuch der Chemie.*

‡ *Ann. de Chimie et Phys.*, xxxiii. 328.

§ Poggendorff's *Ann.*, lxii. 158. 1844.

CALCULI CONSISTING OF PHOSPHATE OF LIME.

Phosphate of lime in a pure state is found as infrequently in the urinary organs of the lower animals as in those of Man. Dr. Thomson analysed a calculus from the urethra of a hog which consisted entirely of phosphate of lime and animal matter. It was of a white colour, of a nearly spherical figure, and was made up of a congeries of very small needles which had a silky lustre. The only concretions in the Museum which belong to this class, with the exception of one said to have been taken from the bladder of a rabbit, are those which have been designated *Beluga stones*. These calculi are found by the fishermen of the Caspian Sea and of the Volga in a species of Sturgeon (*Acipenser Huso*, Linn.). The statements of different authors as to the situation of the stone in the fish, are very conflicting, some describing it as occurring in the air-bladder, others in the head and stomach. In Schrober's *Memorabilia Russico-Asiatica*, as quoted by Klaproth, it is said to be most frequently found in a small pouch communicating with the pancreatic duct; his description is however confused and anatomically incorrect. The subjoined extracts from the works of Pallas* leave no doubt as to these concretions being taken from the dilated ureter or from the common cloacal termination of the gut of the fish.

These concretions have generally a flattened oval figure, their centre being often

* "Les pêcheurs rencontrent assez souvent dans les gros biélougas, la pierre dont j'ai parlé, qui est encore un problème. Ils la vendent à un prix assez modique, de doux à trois roubles. Tous les pêcheurs à qui j'en ai parlé, m'ont assuré qu'on la trouve dans le gros boyau, qui leur sert à se vider et à jeter leurs œufs. On rencontre quelquefois des pierres dans les gros esturgeons ordinaires; elles sont semblables à celles des biélougas. On en trouve aussi dans les gros barbeaux, mais elles sont d'une espèce différente. Les pierres de biélouga sont ovales, unies, et quelques-unes grumelés assez grossièrement; d'autres sont triangulaires et toutes plates. Cette variété, dans la forme et la place qu'elles occupent, prouve que c'est une vraie pierre, et non une arête. Elles ont toutes la couleur et la texture de l'arête. Lorsqu'on les brise, on trouve dans leur substance des rayons luisans spathiques qui tendent de la circonférence au centre; outre la texture écailleuse qu'on destingue à la première superficie, il se détache de l'intérieur de quelques-unes de ces pierres un noyau; il a la même substance que la pierre, mais une autre forme; il ne se trouve pas toujours au centre. J'en ai vu plusieurs qui pesoient jusqu'à trois onces; je les croyois plus pesantes d'après leur grosseur. On peut en raper avec la lame d'un couteau, mais avec peine. J'ai essayé d'en mettre dans des acides et je n'y ai apperçu aucune marque d'effervescence. En Russie, on se sert de cette pierre comme remède domestique, dans les accouchemens laborieux, pour les maladies de l'urètre et celles des enfans; il est très en vogue, et l'on a grand tort. On en fait prendre dans de l'eau à tres-petite dose. On attribue les mêmes vertus, et nombre d'autres, à la pierre qu'on rencontre quelquefois dans la vessie

depressed or slightly concave. They vary considerably in size, but are usually about that of a hen's egg. Their surface is unequal but quite smooth, and of a yellowish-white colour. When broken they present a highly crystalline structure, consisting of fine plates or needles radiating from the centre to the circumference, but which are made up of very thin concentric layers adhering firmly together. Fragments of these calculi are translucent, and their interior is of a pure white colour. They are exceedingly scarce, and are highly esteemed for their supposed medicinal virtues. Dr. Cook informs us that the powder is highly commended as a diuretic and lithontriptic, and that the common people in the neighbourhood of the Volga take from ten to sixty grains, scraped fine in a little water, three or four times a day when the case is dangerous *.

The composition of these calculi was first determined by Klaproth, but the earliest description of them is to be found in the Philosophical Transactions for 1748.

The specimen analysed by Klaproth had been received from Prof. Pallas. It weighed above seven ounces troy, and consisted of Albumen 1, Water 24, Phosphate of lime 71·50, Sulphate of lime 0·50 †.

urinaire des sangliers, qu'on appelle Kabannoï Kamen, pierre de sanglier ; elle est beaucoup plus chère que celle du biélouga."—*Voyages de Pallas*, tom. i. p. 683.

" On fend le cartilage du dos pour en retirer les nerfs ; on les lave et étend sur des perches pour les faire sécher.

" C'est en partageant ce cartilage dans toute sa longueur que l'on trouve quelquefois dans les plus gros ichthyocolles cette pierre si vantée. On ne l'apperçoit que lorsque le couteau s'arrête au moment où il la touche. Cette pierre est renfermée dans la chair rouge glanduleuse, qui est adhérente à la partie postérieure de l'épine du dos, et elle tient lieu de rognons. Elle est dans un petite peau particulière, qui remplit l'intérieur de cette espèce de glande. Je rapporte ici ce que M. Sokolof a pu apprendre de plus certain sur sa vraie position, des pêcheurs les plus instruits, qui assuroient en avoir trouvé quelques-unes. A l'extérieur, elle est un peu molle et humide lorsqu'elle est fraichement tirée, mais elle durcit aussitôt qu'elle est à l'air. C'est dans les pêches qui se font près d'Astrakan qu'on la rencontre le plus souvent. Elle n'est jamais plus grosse qu'un œuf de poule. Elle est ovale et assez plate un peu concave ; où elle a l'angle qui adhère au cartilage un peu courbé."—*Voyages de Pallas*, 1789, vol. ii. p. 486.

" In visceribus uropoeis Husonum maximorum et ætate provectiorum sæpius reperitur *Calculus* ovalis, depressus, hinc concavus, solidus, albus, intus Zeolithi fere instar a centro radiatus, nitidusque, cujus chemica analysis adhuc deest. Hunc plebs Rossica, et honoratiores etiam, pro magno medicamento uragogo et partium promovente æstimant atque infantibus propinant, unde a piscatoribus pretio non exiguo redimuntur, *Calculi Husonis* (Bjelushie Kamen) nomine."—*Zoographia Rosso-Asiatica*, vol. iii. p. 87.

* Phil. Trans. vol. xliv. p. 451.

† *Chemische Abhandlugen*, B. vi. S. 224.

17·13 grs. of one of the specimens in this collection, previously calcined, gave by solution in dilute muriatic acid and precipitation by oxalate of ammonia, 13·87 grs. of carbonate of lime, which is = 17·54 of the diphosphate of lime : 100 grs. of the same calculus gave—

		By calculation.
Water	26·33	25·60 = 5 atoms.
Organic matter	0·40	1·13
Diphosphate of lime	73·27	73·27 = 1 atom.
	100·00	100·00

The Beluga stones therefore consist of an atom of diphosphate of lime combined with 5 atoms of water. The water is necessarily over-estimated in the analysis, on account of the organic matter being partially soluble in the diluted acid.

The great purity of these calculi, together with their transparency and the facility with which they dissolve in diluted acids without causing any effervescence, renders them peculiarly fitted for observing the manner in which the animal matter is combined with the earthy constituents of the calculus. If a small splinter of the calculus is placed under the field of the microscope, and a drop of muriatic or nitric acid, previously diluted with about twenty parts of water, be added, the earthy phosphate begins immediately to dissolve, and the progress of the solvent action is shown by the increased transparency of the sides and angles of the fragment, and by the gradual retrocession of the dark line which marks the boundary of the undissolved portion. A delicate skeleton of animal matter is left which retains for some time the exact figure, size, and general appearance of the original fragment, until at last it becomes broken up and dissolved by the action of the acid. The animal matter viewed in this manner has the form of a fine transparent and slightly granular tissue, marked by some short parallel lines running from the centre to the circumference of the calculus, together with a few transverse lines which indicate the direction of the concentric layers. The membrane is however quite continuous, and cannot by any artifice be made to separate in any particular direction.

If a rather thicker portion of the animal matter be placed between two slips of glass, the radiating lines appear so close together as to give the membrane somewhat of a fibrous structure.

R. *Phosphate of Lime.*

R 1. A portion of one of the concretions that are occasionally found in the dilated ureter of the Sturgeon. For the history of these singular concretions, together with the analysis of this calculus, vide p. 144. It was labelled "From the Sturgeon, Mosco." Vide Plate XIII. fig. 3.

Hunterian.

R 2. A portion of a similar concretion. "From the Beluga, Mosco." It consists of diphosphate of lime, 73·64; water and organic matter, 26·36.

Hunterian.

R 3. A round mammillated calculus, composed of phosphate of lime mixed with carbonate of lime and a little phosphate of magnesia and ammonia, with a considerable portion of animal matter. It is stated in the MS. Catalogue to have been taken from the bladder of a Rabbit.

Hunterian.

CALCULI CONSISTING PRINCIPALLY OF PHOSPHATE OF MAGNESIA AND AMMONIA.

Calculi consisting of this salt are found of considerable purity in the bladder of the Dog and the Hog. They are of a pure white colour, and are either opake or semi-transparent. In the former case they usually contain some phosphate of lime, but, with the exception of their containing a large quantity of animal matter, they are for the most part remarkably pure. Their structure is invariably crystalline, frequently consisting of broad plates radiating from the centre to the circumference of the calculus. M. Caventou analysed a calculus from the Hog which consisted of 99·5 of crystallized triple phosphate with 0·04 of animal matter. The specimen in this Collection from the Hog is equally pure*. The concretions from the Dog are sometimes of very large size; there is one in the Museum which weighs above twelve ounces troy.

S. *Phosphate of Magnesia and Ammonia.*

S 1. A large flattened white calculus tuberculated on its surface. This calculus was taken from the bladder of a Spaniel Dog, which had been ob-

* *Journ. de Pharm.*, xi. 465.

served to void bloody urine for the space of three years, during the whole of which time it was employed in the chase; the animal's sufferings becoming extreme it was killed, and the calculus was found to occupy nearly the entire cavity of the bladder.

Phosphate of magnesia and ammonia with a trace of phosphate of lime and animal matter.

Presented by Sir John Cox Hippisley, Bart., 1820.

S 2. A large oval calculus, taken out of the bladder of a large Mastiff Dog supposed to be nearly twenty years of age; it measures four inches in its long diameter by three inches and two inches and a half in its short diameters, and weighs more than twelve ounces troy.

Phosphate of magnesia and ammonia nearly pure. *Hunterian.*

S 3. A large oblong calculus "taken out of a sickly dog's bladder."—*Sloanian MS. Catalogue.*

Phosphate of magnesia and ammonia mixed with some phosphate of lime and animal matter. *British Museum*, 1809.

S 4. A small oval calculus, stated to have been taken from the stomach of a Hog, but it is doubtless from the urinary bladder.

Crystallized phosphate of magnesia and ammonia upon a small nucleus of carbonate of lime. *Mus. Leverian*, 1806.

S 5. A calculus having the form of a three-sided prism with rounded angles. It is of a white colour, about one inch and three quarters in length, and has a compact lamellated structure. It consists of phosphate of magnesia and ammonia mixed with a small quantity of phosphate of lime and animal matter. It also contains a notable quantity of uric acid deposited between its layers in the form of small radiating prismatic crystals.

This calculus was taken from the urinary bladder of a Whale, which had been brought to Newport, Long Island, North America, and the calculus was sent to Boston by Dr. Jackson of Newport. The bladder contained about a bushel full of calculi, some larger, and others smaller than the present specimen.

Presented by the Boston Medical Society, 1844.

CALCULI CONSISTING OF THE MIXED PHOSPHATES.
FUSIBLE CALCULUS.

The general appearance and chemical characters of these calculi are precisely similar to those which occur in the human subject. The greater number are from the Dog, and it is probable that they are only found in carnivorous and omnivorous animals. There is however a small concretion of this kind in the Museum which was taken from a Monkey, and some others stated in the Sloanian MS. Catalogue to have been found in the bladder of a Horse.

T. *Mixed Phosphates.*

T 1. A section of a large oblong calculus composed of the mixed phosphates.
This calculus is described in the Sloanian MS. Catalogue as from the human subject, but it has most probably been taken from the Dog.
British Museum, 1809.

T 2. An oval "stone taken out of the bladder of a Lap-Dog; from Mr. Dartiknave."—*Sloanian MS. Catalogue.*
Mixed phosphates. *British Museum*, 1809.

T 3. A small triangular-shaped calculus, consisting of the mixed phosphates, taken from the bladder of a Dog.—*Sloanian MS. Catalogue.*
British Museum, 1809.

T 4. An irregularly-shaped calculus from the Monkey, and apparently from the kidney: it consists of the phosphates mixed with urate of ammonia.
Hunterian.

T 5. "Three triangular stones taken out of a Horse's bladder."—*Sloanian MS. Catalogue.* They consist of the mixed phosphates with animal matter.
British Museum, 1809.

T 6. Six small calculi described in the Sloanian MS. Catalogue as "calculi exigui magnitudinem lentium non superantes rubelli ex vesicâ bovinâ."
They consist of the mixed phosphates, and contain urate of ammonia, which renders their assigned origin rather doubtful.
British Museum, 1809.

T 7. A large white calculus of a flattened circular figure, consisting of the fusible compound, mixed with carbonate of lime and a little animal matter. It is described in the Sloanian MS. Catalogue as "an occidental bezoar from Buenos Ayres. From Mr. Ranby."

British Museum, 1809.

T 8. Two fragments of bone encrusted by the mixed phosphates; they appear to have been portions of a fœtal cranial bone, and in the Sloanian MS. Catalogue are stated to have been "taken out of a Hog's bladder, vide the Natural History of Lancashire, Lee." *British Museum*, 1809.

T 9. A small flattened oval calculus, consisting of phosphate of magnesia and ammonia mixed with some phosphate of lime.

Presented by W. T. Brande, Esq., 1841.

CALCULI CONSISTING OF CARBONATE OF LIME, OR OF CARBONATE OF LIME MIXED WITH CARBONATE OF MAGNESIA.

Carbonate of lime forms by far the greater proportion of the concretions from the urinary organs of herbivorous animals. It has never been found in those from the carnivorous tribe; and the fact of the urine of these animals being almost invariably acid, renders it improbable that such should occur. In the Graminivora, on the other hand, whose urine is alkaline, the deposition of carbonate of lime is by no means infrequent; and large quantities of this salt are frequently deposited from the urine of these animals upon standing, which even when first passed is often turbid from the same cause. Of the domestic animals, the Horse and Ox appear to be most liable to these deposits; in the Museum there are also specimens of them in the sedimentary form from the Rhinoceros and the Elephant.

From the Horse (*Equus caballus*).—Calculi from the kidney of the Horse are of very common occurrence, and are easily recognised by their twisted, branched and otherwise irregularly-shaped appearance. They usually form a single mass which often attains a very large size, weighing several pounds. Their external surface is in some parts smooth and polished, in others granular, rough and tuberculated They are exceedingly hard, and when broken present a compact, rudely laminated and sometimes nodulated structure, with a coarse earthy

fracture. Both the exterior and interior of these calculi are of a dirty yellow colour. Concretions similar in composition to, and in many respects resembling those from the kidney, are sometimes taken from the bladder of the Horse. These calculi have usually an ovoid figure. Their texture is in some instances compact, while in others it is porous and granular. They usually present when divided a coarsely radiated and lamellar structure. Vide Plate XIII. fig. 10, 11.

The calculi from the Horse consist of carbonate of lime mixed almost invariably with a small quantity of carbonate of magnesia, and a rather considerable proportion of animal matter. Traces of phosphate, oxalate and sulphate of lime, with the various saline ingredients of the urine, may often be detected. Crystals of oxalate of lime are occasionally scattered over the exterior of the concretions from the bladder.

When a portion of one of these calculi is dissolved in dilute muriatic acid, a mass of organic matter is left, which retains the form of the original fragment, and is seen to consist of successive layers of a fine membrane. When one of the layers is examined by the microscope, it presents the form of a granular transparent membrane, upon which are placed, at irregular distances, and varying in size, a number of nearly circular rings, the centres being almost transparent, while each ring is formed by two or more concentric lines, giving them somewhat the appearance of spheroidal epithelial particles. The animal matter is insoluble in water; when placed in a weak infusion of galls, it becomes much firmer in texture, but its aqueous decoction does not give any precipitate with the same test.

From the Ox (Bos Taurus).—Carbonate of lime concretions from the Ox are seldom of large size. Those from the kidney rarely exceed an inch in length, while those found in the bladder are usually about the size of peas. The latter generally occur in great number, often amounting to several hundreds. They are small rounded globules, usually quite smooth and polished on their surface, but occasionally tuberculated, in which case they resemble *mulberry* concretions. These calculi, whether occurring in the bladder or in the kidney, are generally remarkable for presenting a pearly pseudo-metallic exterior, which gives them the appearance of being slightly gilded or silvered. When broken they readily separate into thin concentric layers, which exhibit a similar lustre on their inner and outer surfaces. The tuberculated calculi, on the contrary,

are exceedingly hard, and do not separate into layers when broken. All the varieties of these calculi are identical in chemical composition with the calculi from the Horse. Vide Plate XIII. figs. 4, 5, 12.

Their animal matter presents the appearance under the microscope of a very thin, transparent and homogeneous membrane thrown into various folds or wrinkles. The edges of the membrane are sharp and well-defined. In its general structure it presents a striking analogy to that found in pearls, and the calculus itself appears to be made up of alternate layers of earthy and animal matter in the same manner as pearl. Many of these concretions were described in the Hunterian MS. Catalogue as "*pearls* from the Ox." In the tubercular variety of these concretions, numerous concentric rings are to be observed in the membrane, similar to those already described as found in some of the concretions from the Horse.

From the Hog (*Sus Scrofa*).—Carbonate of lime also forms the ordinary constituent of calculi from the bladder of the Hog. These calculi vary in size from that of a pea to a large hen's egg. Their exterior is granular or tuberculated. They are extremely hard, and when sawn through exhibit a compact laminated structure, with the appearance of indistinct lines radiating from the centre. They are of a dirty white colour. They always contain a small proportion of carbonate of magnesia, and in their general chemical composition are similar to those from the Horse and Ox. Vide Plate XIII. figs. 1, 2.

V. *Carbonate of Lime.*

V 1. "A stone taken out of the bladder of a Hog."—*Sloanian MS. Catalogue.*
Carbonate of lime with a little carbonate of magnesia and a large quantity of animal matter. *British Museum*, 1809.

V 2. Several calculi taken from the bladder of a Hog. Carbonate of lime mixed with some carbonate of magnesia. 1838.

V 3. Two sections of urinary calculi from the Hog, consisting of carbonate of lime mixed with some carbonate of magnesia. Vide Plate XIII.
Presented by Dr. H. Richardson, 1842.

V 4. "A stone from the kidney of a Mare, three years old, weighing eight

ounces, cut out of a mare which died in Hertfordshire of a total suppression of water. Given to me by Dr. Quinten."—*Sloanian MS. Catalogue.*

Thirty grs. by analysis yielded—

Carbonate of lime	26·11
Phosphate of lime, with a trace of peroxide of iron	0·20
Carbonate of magnesia	0·32
Animal matter, insoluble in water	1·00
Water	0·70
Loss, consisting principally of animal matter soluble in water	1·67
	30·00

Vide Plate XIII. *British Museum*, 1809.

The following calculi are similar in composition to the above, but differ slightly in the relative proportion of the earthy carbonates, the carbonate of lime being always the most abundant.

V 5. "The Hippolithos, or a stone taken from the kidney of a Horse. Given me by Sir Wm. Gifford, who brought it from Portsmouth."—*Sloanian MS. Catalogue.* *British Museum.*

V 6. A large calculus, and several small irregularly-shaped calculi having smooth articulating surfaces. The large calculus was described in the Sloanian MS. Catalogue as "a rough stone taken out of the bladder of a Horse. Given me by Lord Walpole." They are evidently from the kidney. *British Museum*, 1809.

V 7. A large renal calculus, having several smooth depressions on its surface, probably from the Horse. *Hunterian.*

V 8. A large calculus, taken evidently from the kidney of a Horse. *Hunterian.*

V 9. A large calculus, taken probably from the kidney of a Horse. *Museum, Leverian*, 1806.

V 10. A renal calculus, described in the Sloanian MS. Catalogue as from the human subject, but it resembles in every respect the concretions from the kidney of the Horse. *British Museum*, 1809.

V 11. An oval calculus, having a rough tubercular surface. It is composed of carbonate of lime with carbonate of magnesia, and was "voided from the bladder of a five-year old mare, after frequent stopping to stale and staling blood. From Mr. Alderman Wilberforce in Hull."—*Sloanian MS. Catalogue.* *British Museum*, 1809.

V 12. A section of a urinary calculus, which was removed from the bladder of a Horse by an incision through the rectum. The animal belonged to His Majesty King George the Third, and the operation was performed by a German veterinary surgeon. The animal died from peritoneal inflammation, apparently produced by the turpentine dressings introduced into the wound having reached into the cavity of the bladder.

Carbonate of lime mixed with some carbonate of magnesia and a little oxalate of lime. Crystals of oxalate of lime are scattered over its exterior. *Presented by Everard Home, Esq.*, 1807.

V 13. A large calculus, having a tubercular surface. It is composed of carbonate of lime mixed with some carbonate of magnesia: probably from the Horse. *Hunterian.*

V 14. An oval-shaped calculus, having a similar structure and composition to the preceding: probably from the Horse. Its surface is slightly tubercular. *Hunterian.*

V 15. Two small calculi, consisting principally of carbonate of lime, and taken apparently from the kidney of a Horse. *Hunterian.*

V 16. A small calculus, chiefly composed of carbonate of lime: probably from the Hog. *Hunterian.*

V 17. A urinary calculus of a large size, and of a regular oval figure. The nucleus consists of a mass of loosely cohering sediment, which is surrounded first by a granular and very dense deposit, and lastly by thin concentric laminæ. It is composed throughout of carbonate of lime mixed with some carbonate of magnesia. In the Sloanian MS. Catalogue this calculus is described as "an Elephant's bezoar, very large."

British Museum, 1809.

V 18. Masses of a light yellow-coloured earthy sediment, which were found in a pulverulent state in the bladder of a Horse. The bladder was very much enlarged, but its inner surface did not present any unusual appearance.

Carbonate of lime with animal matter, traces of phosphate of lime and peroxide of iron. *Presented by Sir Wm. Blizard*, 1811.

V 19. A mass of urinary sediment, taken in the pulverulent form, from the bladder of a Horse: it is nearly similar in colour and in composition to the former specimen. *Presented by Sir Wm. Blizard*, 1812.

V 20. An exceedingly dense concretion of a regular oval figure, composed throughout of carbonate of lime mixed with a large quantity of carbonate of magnesia. The nucleus and exterior of this calculus consist of thin concentric layers of a light brown colour, and are very compact. The middle and greater portion of the calculus has a radiated structure, the radii being intersected by concentric waved lines. From what animal is unknown, but it resembles in many respects V 17. Concretions similar to these in structure occur in the bladder of the Horse. *Hunterian.*

V 21. A small concretion, which with twenty others was taken from the kidney of an Ox. It consists of carbonate and oxalate of lime.

British Museum.

V 22. Three small renal calculi, described in the Sloanian MS. Catalogue as "calculi ramosi armaturâ æneâ ex renibus bovinis. From Dr. Lavater." The pearly or pseudo-metallic appearance of the exterior of these and the six following calculi is apparently produced by thin films of animal matter intervening between their layers. They are composed of carbonate of lime with some carbonate of magnesia, and their animal matter resembles in structure that of pearls. *British Museum*, 1809.

V 23. "Calculi pisales conglobati læves colore æneo nitentes, ex vesicâ bovinâ. From Dr. Lavater."—*Sloanian MS. Catalogue.*

They consist principally of carbonate of lime.

British Museum, 1809.

V 24. "Calculi lentiformes læves splendore nigricante plumbeo armati, ex vesicâ bovinâ. From Dr. Lavater."—*Sloanian MS. Catalogue.*

Carbonate of lime mixed with carbonate of magnesia and a little phosphate of lime. *British Museum*, 1809.

V 25. "Calculi magnitudine fabæ armaturâ flavâ splendide obducti, veluti in vernice, ex vesicâ bovinâ. From Dr. Lavater."—*Sloanian MS. Catalogue.* Carbonate of lime, with a little carbonate of magnesia. *British Museum*, 1809.

V 26. "Small gold-coloured stones out of the bladder of an Ox, 1674."—*Sloanian MS. Catalogue.* Composition similar to the preceding. *British Museum*, 1809.

V 27. Several small round calculi, composed principally of carbonate of lime. "Ex rene bovis. From Dr. Scheuchzer."—*Sloanian MS. Catalogue.* *British Museum.*

V 28. "Calculi pisales læves, splendore pallido nitentes, ex vesicâ bovinâ."—*Sloanian MS. Catalogue.* Carbonate of lime containing carbonate of magnesia and a trace of phosphate of lime. *British Museum*, 1809.

V 29. Several small concretions, supposed to have been taken from the kidney or bladder of an Ox. They consist of carbonate of lime mixed with some carbonate of magnesia. *Hunterian.*

V 30. Numerous small round calculi, the largest of which are tuberculated on their surface. They were taken from the bladder of an Ox, and are composed of carbonate of lime mixed with carbonate of magnesia. *Hunterian.*

V 31. Several small spherical concretions. "From the bladder of an Ox." Composition similar to the preceding. *Hunterian.*

V 32. Some small concretions, taken from the prepuce of the Hermaphrodite Ass, described by Mr. Hunter in the Philosophical Transactions. Carbonate with a trace of phosphate of lime. *Hunterian.*

V 33. Several small flattened concretions "taken out of the bladder of a Tortoise."—*Sloanian MS. Catalogue.* They do not possess a lamellar structure, and are composed of carbonate of lime with animal matter. *British Museum*, 1809.

V 34. A urinary calculus from an Otaheitian Pig. This calculus in its general appearance and chemical composition resembles that figured in Plate XIII., but it is much larger. *Presented by Everard Home, Esq.*, 1807.

V 35. Pulverulent deposit taken from the bladder of a Horse, the bladder being much enlarged. It consists principally of carbonate of lime.
Presented by Everard Home, Esq., 1807.

V 36. Sediment from the urine of a Rhinoceros which was exhibited at the Lyceum in the Strand in the year 1792. The animal was of the single-horned African species. Its urine was very turbid when passed, and when this deposit was taken the animal was so weak that it was obliged to be supported by slings; it died shortly after. The sediment consists almost entirely of carbonate of lime mixed with a little oxalate of lime. The carbonate of lime is in the form of small prismatic crystals and of minute rounded globules. *Hunterian.*

V 37. A small quadrilateral-shaped calculus, consisting of carbonate of lime.
Presented by W. T. Brande, Esq., 1841.

V 38. Two small irregularly-shaped concretions taken from the kidney of a Cow. Their surface is extremely rough and tubercular, and they are composed of carbonate of lime mixed with a little carbonate of magnesia and animal matter. *Presented by J. D. Hudson, Esq.*, 1844.

CALCULI CONSISTING OF SILICA.

M. Lassaigne has described a calculus composed of silica mixed with a little peroxide of iron and animal matter. It was found in the urethra of a male Merino lamb. It was of a white colour with a slight shade of red, very friable, and had a cylindrical figure tapering towards the extremities. It was made up of concentric layers which adhered very slightly to each other.—*Ann. de Chim. et de Phys.* xliv. p. 420.

PART II.

Division I.

CALCULI FROM THE DIGESTIVE TRACT OF MAN.

FROM THE BILIARY ORGANS.

INTRODUCTION.

THE concretions which sometimes form in the gall-bladder and in the biliary ducts do not appear to have attracted the notice of physicians at so early a period as those of the kidney and urinary bladder. According to Dr. Coe, whose Treatise on Biliary Concretions, published in 1757, contains the largest amount of historical information on this subject, no mention is made of these bodies in the writings of the ancients, and he believes that the earliest notice of them is to be found in the works of Benevenius, Fallopius, Vesalius and Fernelius, who lived about the middle of the fifteenth century. Benevenius speaks of a "large black calculus of the size of a chestnut found in the gall-bladder of a woman, and that there were in the same subject many stones contained in a pendulous bag formed of the membrane that covered the liver*." To Fernelius, however, Dr. Coe attributes the principal merit of directing the attention of the medical profession to gall-stones as a source of disease, and also believes that Fernelius was the first to observe that they were occasionally voided by stool.

In Gesner's *De omni Rerum Fossilium Genere*, there is a dissertation by Kentmann on several species of calculi found in the human body, and among them

* *De abditis Morborum causis*, cap. 94, as quoted by Dr. Coe.

those of the gall-bladder are noticed. This treatise was published in 1565, about seven years after the death of Fernelius.

The importance of the liver as an excretory organ and its influence on digestion, together with the severe pain and symptomatic fever attending the passage of a gall-stone through the biliary ducts, contributed to render the bile and biliary concretions a favorite subject of speculation with a large number of medical authors. S. T. Sœmmering, in a very excellent monograph entitled *De Biliariis Concrementis Corporis Humani*, published in 1795, has taken the pains to collect above two hundred references to different works on this subject. In all of these we find more or less accurate descriptions of the form, size and general appearance of biliary calculi, but without any information as to their chemical nature. Dr. Coe, writing in 1757, says, that "they evidently consist of the gross tenacious dregs of bile, and an earthy substance separated from the blood of a similar nature to that of which the urinary calculus and the gouty chalk-stones are composed." In fact, prior to the experiments of Fourcroy in 1798, the general opinion appears to have been that they were composed of inspissated bile, although the simplest experiment would have shown that the bile, when reduced to the state of an extract, forms a highly soluble and even deliquescent mass, and was not therefore very likely to become a solid concretion. It is however still more remarkable that this unmeaning term has been applied by a modern author to the ordinary gall-stones of oxen, and is even at the present time in general use. About the year 1785 Poulletier de la Salle first observed that the greater number of biliary calculi were soluble in hot alcohol, and that upon cooling a number of brilliant crystals, like those of benzoic acid, were separated. He also ascertained that this substance was not present in the gall-stones of oxen. The latter concretions had been known most probably much earlier than those of the human subject, but had always been considered as similar to those from Man. These facts were communicated by Poulletier de la Salle to Fourcroy, who conceived that the crystalline matter was analogous to spermaceti and a fatty matter which he had procured from putrid liver and brain, to which he had given the generic name of *adipocire*. These calculi he therefore termed adipocerous*.

* *Syst. des Connaissances Chimiques.*

The experiments of Fourcroy on biliary calculi appeared at the same time as those on urinary concretions. They are however of much less value than the latter, and in his haste to generalize, he fell into numerous errors. A much better description of the principal constituent of human biliary calculi had been previously given by C. Gren* in 1788, who merely called it a waxy-looking substance. It was afterwards shown by Chevreul, in his celebrated Essay on Fatty Bodies, that the crystallizable fatty matter was a peculiar substance, to which he gave the name of cholesterine, by which title it is now universally known†.

Although it had been ascertained by Poulletier de la Salle that the biliary calculi of the Ox are very different in composition from those of the human subject, it was not until the year 1806 that their composition was determined, when Thenard showed that they consist of the same matter that gives to bile its usual brown colour‡. Oxen are particularly subject to concretions in the gall-bladder, great numbers of which are imported into this country from Germany for the use of painters. Glisson asserts that they are met with principally in the winter, when the animals are fed chiefly upon hay and straw, and that upon the approach of spring, or as soon as they are fed upon fresh grass, the calculi disappear, being dissolved and expelled by the fresh juices of the grass, and by the purging which is the consequence of the change of food §. It was upon this notion of Glisson's that Van Swieten recommended a decoction of grass and other herbs as a cure for jaundice, and several curious instances of the success attending this mode of treatment are recorded. Among others, is the case of a poor man who for two years lived by his directions almost wholly upon grass, taking it boiled in broth as his ordinary food, and drinking the decoction sweetened with honey. The patient was not only completely cured of his malady, but became so great a connoisseur in this novel diet, that he could tell which were the richest pastures by the taste of the grass. Moreover he consumed such quantities that the farmers drove him from their fields by force, so that in addition to his other calamities he was compelled to obtain it by stealth.

The brown colouring matter of the bile is almost always present in the ordinary cholesterine calculus of the human subject, but it is very rarely found in a pure state; such concretions have, however, been described by Dr. Prout in his

* Crell, *Beitrage zu den Chem. Ann.*, iv. 1, 19.

† *Ann. de Chim. et de Phys.*, xcv. 5.

‡ *Mém. d'Arcueil*, i. p. 59.

§ *De Hepate*, p. 89.

work on Diseases of the Stomach and Urinary Organs : and there are several calculi of a similar description in the Museum which were arranged by Mr. Hunter among the human biliary concretions ; it is however probable that some of these were taken from the Ox.

Biliary calculi are for the most part so very impure, and, with the exception of the cholesterine calculus, so little is known of their composition, that it is exceedingly difficult to offer any arrangement of these bodies which shall be free from objection. The classification of Walther*, which was founded upon the structure and obvious characters of the calculi, was proposed at a time when chemistry had thrown no light upon their composition. Vicq d'Azyr was perhaps the first who attempted anything like a chemical arrangement. He divided them into three classes ; in the first class he placed those consisting of a yellow bilious matter (*colouring matter of the bile*) ; in the second those composed of a brilliant crystalline matter (*cholesterine*) ; and the third comprehended the mixed biliary concretions, or those which contained the constituents of the two former classes†.

After the discovery of cholesterine, Fourcroy refined upon this arrangement ; but his classification is very artificial, and much less useful than that of Vicq d'Azyr ; it is therefore unnecessary to quote it in this place‡.

Dr. Thomson, in his recent work on Animal Chemistry, arranges biliary calculi under five classes. The first class includes those composed of pure cholesterine. The second those which likewise consist of cholesterine, but also contain the colouring matter of the bile, and some unaltered bile ; the latter concretions are generally present in large numbers, and are of a polygonal figure. The third class are composed of inspissated bile, by which term must be meant the colouring matter of the bile, especially as these calculi are described as having a brown colour, and being more common in the gall-bladder of the inferior animals than in that of Man. The fourth class comprehends gall-stones which do not flame, but gradually waste away at a red heat. These are supposed to consist principally of carbon.

To these four classes must be added the concretions which consist principally of the earthy carbonates.

* *Anatomisches Museum.*

† *Recueil Périodique de la Société de Médecine.*

‡ *Op. cit.*

During the examination of this collection, two new species of biliary calculi have been discovered. One of these resembles in many particulars the ordinary calculi from the Ox, composed of the brown colouring matter of the bile, but it is distinguished from them by its want of a lamellar structure, by its black colour and by its homogeneous and resinous fracture, which give it the appearance of a mass of pitch. It also differs in not being precipitated from its potass solution in the form of green flocks. Of this species of calculus there is only one specimen in the Museum in which the peculiar matter is in a tolerably pure state, but there are several others in which it apparently exists mixed with the brown colouring matter of the bile. As this substance is closely allied to, or is perhaps some modification of the brown colouring matter of the bile, it has not been considered expedient to erect it into a separate class, or to designate it by any particular name until its properties and those of the yellow colouring matter of the bile have been more thoroughly examined. These calculi have therefore been arranged as a sub-species of the ordinary brown biliary concretion.

The other new species of calculus was found to consist of stearic and oleic acids in combination with lime.

The biliary calculi in this collection have been divided into the following classes.

Class I. Calculi consisting principally of cholesterine.

Class II. Calculi consisting principally of the brown colouring matter of the bile, or of substances allied to it, and are divided into two varieties, α and β.

Var. α consists of calculi composed of the brown colouring matter of the bile,—*Matière jaune de la Bile*, Thenard; *Gallenbraun*, Gmelin; *Beliphaein*, Simon; *Cholepyrrhine*, Berzelius. These concretions are but rarely found in the human subject, but form the ordinary gall-stone of oxen.

Var. β. Non-laminated calculi, of a black colour and having a resinous lustre. These calculi chiefly occur in the human subject, and are generally mixed with more or less of the brown colouring matter of the bile.

Class III. Calculi consisting of the fatty acids (*stearic, margaric and oleic acids*), either pure or in a state of combination. The only concretion of this kind that has been described was found in this collection. It consisted of the stearate and oleate of lime*.

Class IV. Calculi consisting of the earthy carbonates.

* London and Edinburgh Philosophical Magazine, July 1840.

CALCULI CONSISTING PRINCIPALLY OF CHOLESTERINE.

Cholesterine forms the principal and ordinary constituent of human biliary calculi. It is sometimes found in nearly a pure state, but it usually occurs mixed with more or less of the yellow or brown colouring matter of the bile.

There are several varieties of the cholesterine calculus, which, although they resemble each other in their chemical composition, may nevertheless be distinguished by their general appearance. It may therefore be well to enumerate a few of the leading forms which this substance assumes when deposited as a solid concretion in the gall-bladder. First among these are the calculi which consist of nearly pure cholesterine. These calculi are externally of a white or light yellow colour. Their exterior is usually smooth, but sometimes distinctly crystalline. They are translucent, sometimes transparent, have a greasy feel, and acquire a waxy lustre by slight friction. When broken they present a crystalline structure, consisting of broad semitransparent plates, radiating from the centre to the circumference, and having a brilliant lustre like that of spermaceti. This variety is not very common; it frequently attains a large size and is seldom accompanied by other concretions. Vide Plate XVII.

Another variety of these concretions may be noticed, in which the gall-bladder is filled by two, three or four calculi, most commonly three. They are seldom so pure as the preceding variety: they are usually of a cylindrical figure, and are applied end to end, and have smooth articulating surfaces at the points of contact, the rounded extremity of one being often received into a cup-like depression of another. It is more common, however, to find several concretions in the gall-bladder differing considerably in size and general figure. When thus packed together in the gall-bladder they acquire a polygonal figure, and from the constant yet limited motion which that viscus is subjected to in respiration, they become polished, and acquire smooth flattened sides or faces. When several calculi are present and are nearly uniform in size, their figure is generally regular. When, on the other hand, there are but few, and these differ considerably in size, their figure is very various.

In this Collection there are several instances of many thousands of these con-

cretions taken from the same gall-bladder; the largest of the calculi not exceeding in size a millet seed. Their exterior is of various shades of colour, from pure white to brown and almost black; most commonly they are mottled with white and brown. The smaller concretions are very frequently varnished over with a layer of pure cholesterine.

The impure varieties of the cholesterine calculus when broken exhibit a considerable diversity of appearance, obviously depending upon the more or less perfect crystallization of the cholesterine, and upon the relative proportion which it bears to the colouring matter of the bile and to the other ingredients with which it is mixed. Sometimes broad plates of nearly pure cholesterine, imbedded in the yellow matter of the bile, radiate from a small nucleus of that substance. More frequently their interior consists of minute needles, which are tinged of a yellowish brown colour and have a lamellar structure. They also vary considerably in their specific gravity, but for the most part float upon water.

Biliary calculi which have passed by stool do not differ in composition from those found in the gall-bladder; they are often, however, of such a size as to render it probable that they have increased in bulk while in the intestines. That they have in the first instance been formed in the gall-bladder is shown by the absence of a nucleus of undigested food, &c., which would undoubtedly exist had their formation commenced in the intestines. No such specimen, however, exists in this Collection.

In addition to the yellow matter of the bile, cholesterine calculi almost invariably contain mucus of the gall-bladder, unaltered bile (choleate of soda), carbonate and phosphate of lime, with the soluble alkaline salts of the bile. Small quantities of the fatty acids, with traces of carbonate of magnesia, oxide of iron and silica, are also occasionally present.

Cholesterine calculi readily melt when heated, give out a peculiar resinous odour, catch fire and burn with a white smoky flame, a copious carbonaceous ash is left, containing the earthy and alkaline salts of the calculus, which, owing to the presence of carbonate of soda, may often be fused before the blowpipe. When digested in boiling alcohol, the cholesterine dissolves, while the yellow matter of the bile and mucus are left undissolved. The alcoholic solu-

tion, on cooling, deposits brilliant soft plates or spangles of pure cholesterine. If, on the other hand, the calculi are digested in a solution of potass, the colouring of the bile is removed and the cholesterine left unacted on. By the action of these reagents, together with their general appearance, the nature of these concretions may be readily determined.

Cholesterine is a peculiar body, which in appearance resembles spermaceti: it is distinguished from that substance by not being converted into a soap when boiled with an alkali, and also by requiring a temperature of 278° Fahr. for its fusion. It is tasteless, inodorous, and insoluble in water, but readily dissolves in æther, either hot or cold. Boiling alcohol freely dissolves it, but the greater part is deposited on cooling. Minute crystals of cholesterine, when examined by the microscope, are seen to consist of very thin rhombic plates. By the action of nitric acid it is converted into a crystalline acid termed cholesteric acid. Cholesterine is a natural constituent of the bile of Man, of the Ox, the Dog, and the Pig*. It also enters into the composition of the brain†, and crystals of this substance may often be observed floating in the spirit in which brains are preserved. Cholesterine is also a frequent product of disease; it has been detected in the fluids of hydrocele, ascites, and ovarian cysts; in the contents of an abscess, and in various solid and malignant tumours. According to Fromherz and Gugert, it enters into the composition of the sebaceous matter, *Vernix Caseosa*, which covers the fœtus. Cholesterine obtained from the brain is rather less fusible and dissolves more readily in alcohol than that from gallstones; in their ultimate composition both varieties are, however, the same.

According to the analysis of Chevreul, Couerbe and Pelletier, 100 parts of cholesterine consist of—

Carbon	85·095	84·895	83·37
Hydrogen . . .	11·880	12·099	13·32
Oxygen	3·025‡	3·006§	3·31‖
	100,000	100,000	100,00

* Chevreul, Majendie, *Journ. de Phys.*, iv.
† *Ann. de Chim. et de Phys.*, lvi.
‡ Pelletier, *Ann. de Chim. et de Phys.*, li.
§ Couerbe, *Ann. de Chim. et de Phys.*, lvi.
‖ Chevreul, *Journ. de Phys.*, iv.

A. *Cholesterine.*

A 1. A small oval calculus, consisting of two portions: the inner is composed of cholesterine slightly tinged by the colouring matter of the bile, while the outer portion, which covers nearly the whole of the inner, is composed of perfectly pure cholesterine, transparent, and beautifully crystalline on its exterior. *Presented by J. Boutflower, Esq.*, 1843.

A 2. A flattened oval calculus, broken transversely, having the following history in the Sloanian MS. Catalogue.

"A stone voided whole per anum in November 1728, by a lady about fifty years of age. She complained, some hours before it came away, of great pain in her bowels. Upon taking a glyster it came away without any blood, and she was immediately easy and well."

This calculus is composed of very pure cholesterine, apparently deposited upon a small nucleus of the colouring matter of the bile. It is made up of sparkling semi-transparent plates, radiating from the centre to the circumference of the calculus, and exhibits the crystalline structure of this species of calculus in a very characteristic manner.

British Museum, 1831.

A 3. An oval calculus about the size of a nut, consisting of pure cholesterine: its exterior is highly crystalline.

Presented by Sir William Blizard, 1811.

A 4. An oval calculus, measuring one inch three quarters in length by one inch and a half in diameter, which was passed per anum by a Mrs. Smart. Its centre is composed of nearly pure crystallized cholesterine, while its exterior consists of cholesterine mixed with the colouring matter of the bile. *Presented by H. P. Fuller, Esq.*, 1819.

A 5. A large biliary calculus, which was passed per anum by the sister of the lady from whom the preceding calculus was voided. It resembles the former in composition, and its centre is also composed of much purer cholesterine than its exterior.

Presented by H. P. Fuller, Esq., 1819.

A 6. A similar calculus, but much smaller, which was passed per anum by a woman. *Presented by William Lynn, Esq.*, 1820.

A 7. A small oval calculus, consisting of nearly pure cholesterine, taken from the gall-bladder of a gentleman who died in his seventy-seventh year: there was no bile in the gall-bladder, but a small quantity of a limpid fluid. *Presented by Charles Hatchett, Esq.*, 1832.

The following four calculi are nearly similar in size and general appearance, they are composed of nearly pure cholesterine, and their external surface is crystalline.

A 8.
A 9.
A 10.
A 11. } *Hunterian.*

A 12. One hundred and twenty small irregularly-shaped calculi, taken from the same gall-bladder. They are composed of nearly colourless cholesterine. *Hunterian.*

A 13. Numerous small calculi, similar in appearance and composition to the preceding, but rather larger. They were taken from the same gall-bladder. *Hunterian.*

A 14. A large oblong calculus, consisting of cholesterine mixed in parts with the colouring matter of the bile. *Hunterian.*

A 15. A small rounded calculus, consisting of nearly pure cholesterine. *Hunterian.*

A 16. A nearly spherical calculus, tuberculated on its surface, consisting of almost pure cholesterine. "From the gall-bladder." *Hunterian.*

A 17. A transverse section of a calculus, composed of nearly pure cholesterine. *Hunterian.*

A 18. A large biliary calculus, similar in composition to the preceding. *British Museum.*

A 19. Four small cholesterine calculi, having a rounded figure and tuberculated exterior. *Hunterian.*

A 20. Six small spherical calculi, composed of nearly pure cholesterine, tuberculated on their exterior, and taken from the same gall-bladder.

Hunterian.

A 21. A large oblong calculus, composed of cholesterine tinged with the colouring matter of the bile. *Hunterian.*

A 22. Numerous small calculi, consisting of pure cholesterine. Their figure is very irregular, and they contain so little colouring matter as to render them semitransparent. From a female who died of strangulated hernia.

Presented by Joseph Swan, Esq.

A 23. A large cylindrical calculus, truncated at each end, consisting of cholesterine mixed with the colouring matter of the bile, particularly at the exterior. *Hunterian.*

A 24. A similar calculus, tinged throughout with the colouring matter of the bile. *Hunterian.*

A 25. A small round calculus composed of crystallized cholesterine, tinged throughout with the colouring matter of the bile, but of a much darker colour than the preceding specimen. *Hunterian.*

A 26. Two biliary calculi, each of the size of a nut. One of them is divided, and consists of nearly pure cholesterine; the exterior of the other is coated with a crust of the colouring matter of the bile, and appears to have been attacked by insects. *Hunterian.*

A 27. An irregularly-shaped calculus, composed of cholesterine partially mixed with the colouring matter of the bile. *Hunterian.*

A 28. Two oval calculi, composed of nearly pure cholesterine.

Presented by John Gunning, Esq., 1816.

A 29. Two calculi, taken from the same gall-bladder, consisting of cholesterine nearly pure at the exterior, but mixed with the colouring matter of the bile at the centre. *Hunterian.*

A 30. A cylindrical calculus truncated at each extremity, and another of an ir-

regular figure, taken "from Mr. Clarke." They resemble in composition the preceding specimens. *Hunterian.*

A 31. A cholesterine calculus, mixed with the colouring matter of the bile. *Hunterian.*

A 32. Three calculi, taken from the gall-bladder of Sir George Howard. They have smooth, mutually adapted surfaces, and are composed of nearly pure cholesterine. *Presented by Thomas Keate, Esq.*, 1811.

A 33. An oval calculus, tuberculated on its exterior. Composition similar to the preceding. *Hunterian.*

A 34. Four small calculi, and an elongated calculus, having a smooth flattened surface at one extremity. They are composed of cholesterine mixed with the colouring matter of the bile. *Hunterian.*

A 35. Three large impure cholesterine calculi, apparently taken from the same gall-bladder, the entire cavity of which they must have filled. They have broad, mutually adapted surfaces, and when placed in contact with each other measure nearly four inches in length; their exterior is extremely rugged. *Presented by John Gunning, Esq.*, 1816.

A 36. Two cholesterine calculi, each about the size of a large nut: they have smooth, mutually adapted surfaces at their extremities, and are probably from the same gall-bladder. *Presented by John Gunning, Esq.*, 1816.

A 37. Two impure cholesterine calculi, taken from the same gall-bladder. One is oblong and flattened at either end; the other is angular. *Presented by Sir William Blizard*, 1811.

A 38. A large oval impure cholesterine calculus, which has a smooth depression at one end from having been in contact with another calculus. *Hunterian.*

A 39. A large oblong impure cholesterine calculus. *Hunterian.*

A 40. A nearly similar calculus, having one of its ends flattened.

Hunterian.

A 41. A biliary calculus, extracted by Sir William Blizard from a fistulous opening situated midway between the umbilicus and pubes. The following are the particulars of the case:—

"Susannah Walker, aged sixty years, was admitted into the London Hospital the 27th of March 1813, on account of a fistulous opening, situated midway of the navel and pubes, from which, she stated, had passed, some time in the last summer, within the space of a week, three stones of the appearance of chestnuts, of the size each of a small nutmeg.

"She had for nearly a year experienced pain in the abdomen, especially near the affected part, but had never suffered particularly in the region of the liver, nor had she ever been jaundiced or subject to any complaint, only had been habitually costive.

"A probe upon introduction passed freely in a sinus, obliquely to the right upwards, and at about the depth of two inches from the surface of the skin struck against a hard body, whereupon the passage was enlarged, and by it extracted a stone, apparently biliary, of the size of a small walnut, and which the woman said resembled the three stones which were discharged in the summer.

"The wound healed kindly, and in a month the patient was dismissed cured."

The central portion of this calculus consists of cholesterine mixed with the colouring matter of the bile, while the exterior is composed of nearly pure cholesterine. The smaller extremity of the calculus is concave and smooth, as if produced by contact with another stone.

Presented by Sir William Blizard, 1813.

A 42. A large biliary calculus, which was voided per anum by a lady above sixty years of age. She had been subject for several years to severe paroxysms of pain in the right hypochondrium, which were always attended with vomiting, but without any febrile symptoms; these attacks usually lasted two or three hours, until relieved by large doses of laudanum; on one of these occasions aperients were administered, and after some time the

calculus was voided, from which time the patient was quite relieved from her former sufferings. She never had jaundice, nor were her evacuations at any time clay-coloured. It consists of impure cholesterine.

Presented by J. Carrick Moore, Esq., 1824.

A 43. Four gall-stones and a portion of a fifth, which were passed per anum by a woman about thirty years of age. *Hunterian.*

A 44. An elongated conical-shaped calculus, which has been apparently moulded in the neck of the gall-bladder. It consists of cholesterine, containing thin layers of the colouring matter of the bile.

Presented by John Gunning, Esq., 1816.

A 45. A biliary calculus, about the size and figure of a small chestnut, similar in composition to the preceding specimen.

Presented by John Gunning, Esq., 1816.

A 46. A large biliary calculus and the half of another, which were removed from the same gall-bladder. The larger calculus has two smooth depressions on opposite sides of one of its ends.

Presented by Sir William Blizard, 1808.

A 47. Numerous small calculi, being the contents of one gall-bladder. The exterior of these calculi consists of nearly pure cholesterine, while their nucleus is mixed with the colouring matter of the bile. *Hunterian.*

A 48. Several small calculi, "from the gall-bladder of a man." They are similar in composition to the former. *Hunterian.*

A 49. A large cylindrical gall-stone, truncated at both ends. Cholesterine mixed with the colouring matter of the bile.

Presented by Sir William Blizard, 1811.

A 50. Two small cholesterine concretions. *Hunterian.*

A 51. Seven angularly-shaped cholesterine calculi. *Hunterian.*

A 52. A nearly spherical calculus of a dark colour, consisting of cholesterine mixed with the colouring matter of the bile. *Hunterian.*

A 53. Numerous small polygonal-shaped calculi, being the contents of one gall-bladder. Their exterior is mottled with white and various shades of brown, according as the cholesterine is pure or is mixed with the colouring matter of the bile: some of them have been deposited upon a nucleus of the latter substance. *Hunterian.*

A 54. A similar series of small biliary calculi; all of them are stated to have been taken from one and the same gall-bladder, but are unaccompanied by any other history. *Hunterian.*

A 55. Twenty-one small calculi, similar in composition and appearance to the foregoing. "From the gall-bladder of Lord Holderness." *Hunterian.*

A 56. A small cholesterine calculus, having several flattened faces. *Hunterian.*

A 57. Seven dark-coloured irregularly-shaped cholesterine calculi, taken apparently from the same bladder. *Presented by Sir Wm. Blizard*, 1811.

A 58. A small oval-shaped cholesterine calculus, the exterior of which is of a dark brown colour. *Presented by Sir William Blizard*, 1811.

A 59. "A gall-stone from Mrs. Collier, aged forty-seven, who had also stricture of the œsophagus, the preparation of which is in the Museum." Its exterior is tuberculated and consists of nearly pure cholesterine, while its interior contains some of the colouring matter of the bile. *Presented by Sir E. Home*, 1807.

A 60. Four small white cholesterine calculi. *Hunterian.*

A 61. Three small polygonal-shaped cholesterine calculi, with fragments of two others, taken from the same gall-bladder. *Hunterian.*

A 62. Four small cholesterine calculi; the nucleus of one consists of the colouring matter of the bile. *Hunterian.*

A 63. Three small dark-coloured cholesterine calcul, "from Mrs. Wagger, who had cancer of the uterus." *Hunterian.*

A 64. Eight small polygonal-shaped cholesterine calculi, taken from the same gall-bladder. *Hunterian.*

A 65. A large irregularly-shaped gall-stone, the inner and greater part of which consists of nearly pure cholesterine, while the exterior is principally composed of the colouring matter of the bile. *Hunterian.*

A 66. Two small angularly-shaped cholesterine calculi. *Hunterian.*

A 67. Five small angularly-shaped cholesterine calculi. *Hunterian.*

A 68. Numerous small calculi, being the contents of one gall-bladder: some of them are extremely minute; they have a peculiar pearly lustre, and are composed for the most part of cholesterine. *Hunterian.*

A 69. A similar series, but the calculi are much larger in size and fewer in number; they also want the pearly-looking surface. *Hunterian.*

A 70. A biliary calculus about the size of a chestnut, having flattened sides, and consisting of impure cholesterine. *Leverian Museum.*

A 71. A small tuberculated biliary calculus, consisting of impure cholesterine. *Presented by Sir Anthony Carlisle,* 1821.

A 72. Several calculi taken from the same gall-bladder. Most of them have an angular figure, and the largest contains an entire layer of the colouring matter of the bile. *Hunterian.*

A 73. Seven irregularly shaped calculi, from the same gall-bladder. They consist of nearly pure cholesterine. *Hunterian.*

A 74. Several small biliary calculi, similar in composition to the preceding. *Hunterian.*

A 75. Numerous small rounded tuberculated calculi, taken from the same gall-bladder. They consist of impure cholesterine. *Hunterian.*

A 76. Two flattened calculi, taken from the gall-bladder of a subject in Mr. Hunter's dissecting-room. One of them has been divided; it consists of pure cholesterine deposited upon a friable brown mass, consisting almost wholly of the colouring matter of the bile. *Hunterian.*

A 77. Thirty-one calculi about the size of peas, and of a polygonal figure, which were taken from the same gall-bladder. They consist of impure cholesterine. *Hunterian.*

A 78. Eleven small calculi, consisting of impure cholesterine, and taken from the same gall-bladder. *Hunterian.*

A 79. Four calculi similar to the preceding. *Hunterian.*

A 80. An egg-shaped biliary calculus, divided transversely and measuring nearly two inches in length. It consists of impure cholesterine, and has the following history in the Sloanian MS. Catalogue :—

"A large stone voided by stool by a gentlewoman (Mrs. Anne Wright) who had been many years troubled with the colic."

British Museum.

A 81. Two large calculi, consisting of impure cholesterine. One of these has been divided; it is of a cylindrical figure, and has mutually adapted surfaces at each end. It measures about one inch and a half in length by one inch across, and weighs rather more than half an ounce. The other is nearly globular, and weighs rather less than two drachms.

These calculi were expelled through a fistulous opening in the parietes of the abdomen communicating with the gall-bladder, many years before the death of the patient (the Bishop of Chichester), from whom also was taken the preparation in the Museum of a pouch in the œsophagus. The opening in the abdomen remained for a considerable time, but finally closed. The following account of the state of the parts accompanied the calculus :—

"Immediately opposite to an external cicatrix, formed by the passage through which the gall-stones had escaped, the fundus of the gall-bladder adhered closely and firmly to the peritoneum, and instead of occupying its proper situation under the liver, lay strongly stretched over its surface, the latter being greatly diminished in size. No bile was contained in the gall-bladder, but about a small tea-spoonful of fluid, both colourless and tasteless. As its duct was obliterated it would appear to have been long since a useless appendage to the system. The patient died at the advanced age of ninety." *Presented by William Guy, Esq.*, 1824.

A 82. Two small cholesterine calculi.
From the collection of Dr. Wright of Lichfield.
Presented by Dr. G. Power, 1821.

A 83. A cylindrical-shaped calculus, having a flattened smooth surface at each extremity, and consisting of impure cholesterine. *British Museum.*

A 84. Three biliary calculi, apparently not from the same gall-bladder. One of them consists of nearly pure cholesterine surrounded by a thick crust consisting chiefly of the colouring matter of the bile. Another is composed almost wholly of the colouring matter of the bile, and has been attacked by insects ; the third is an ordinary cholesterine concretion.
Hunterian.

A 85. Two small quadrilateral calculi composed of impure cholesterine.
Hunterian.

A 86. A small impure cholesterine calculus, having several flattened sides.
Presented by Sir William Blizard.

A 87. Four small irregularly-shaped cholesterine calculi. *Hunterian.*

A 88. A section of a small conical-shaped cholesterine calculus.
British Museum.

A 89. A very regularly egg-shaped calculus, above an inch in length. Its external surface is reticulated with dark lines. It is composed of impure crystalline cholesterine deposited upon a nucleus of the colouring matter of the bile. *Presented by John Gunning, Esq.*, 1816.

A 90. A section of a large impure cholesterine calculus. *Hunterian.*

A 91. Fragments of a flattened cholesterine calculus ; the exterior consists principally of the colouring matter of the bile. *Hunterian.*

A 92. Three dark-coloured calculi, composed of impure cholesterine. From the same gall-bladder. *Presented by Everard Home, Esq.*, 1807.

A 93. A few small cholesterine calculi.
"Lapilli e vesicula bilis humana."—*Sloanian MS. Catalogue.*
British Museum.

A 94. An oblong cholesterine calculus, having a rough external coat composed principally of the colouring matter of the bile.

"This calculus was voided per anum by Phillip Thicknesse, Esq., in 1768, after suffering considerable pain: several smaller concretions had been passed about ten years previous."

Presented by Everard Home, Esq., 1808.

A 95. A considerable number of small cholesterine calculi, having the following history in the Sloanian MS. Catalogue:—"The gall-bladder of Dr. Walter Charlton, full of angular gall-stones. The end of it was joined to the peritoneum, from whence gall was discharged by a tumour which turned to an ulcer in the side. From Mr. Cowper."

British Museum.

A 96. Several small cholesterine calculi, apparently taken from the same gall-bladder.

British Museum.

A 97. Three impure cholesterine calculi.

Hunterian.

A 98. Three calculi similar to the preceding, but larger.

Presented by J. Gunning, Esq., 1816.

A 99. Four cholesterine calculi, apparently taken from the same gall-bladder. Two of them are united together; all of them have flattened surfaces.

British Museum.

A 100. An elongated oval calculus which was expelled through an abscess in the parietes of the abdomen. It measures rather more than two inches in length by one inch across, and is composed of concentric layers of cholesterine, mixed uniformly with the colouring matter of the bile, surrounding a nucleus of nearly pure cholesterine.

Presented by John Abernethy, Esq., 1824.

A 101. A small biliary calculus, the exterior of which is composed of carbonate of lime; it has a dark brown colour, and is deeply grooved like the surface of some Madrepores. The inner and larger portion of the calculus consists of cholesterine tinged with the colouring matter of the bile.

Presented by Sir William Blizard, 1809.

A 102. An impure cholesterine calculus, the external surface of which consists of carbonate of lime, and is of a dark brown colour.

"From a patient of the name of Laird."

Presented by Everard Home, Esq., 1807.

A 103. A large oblong calculus, broken transversely, which was accompanied by the following history:—"Ann Aldred, æt. 71, had violent pains in her sides during a period of three months, at the termination of which she evacuated a gall-stone per anum with considerable difficulty unaccompanied by fæces. Immediate cessation of pain ensued, and four months have now elapsed without any return of her complaints."

This calculus consists of nearly pure cholesterine, deposited upon a small nucleus of the colouring matter of the bile, mixed with a large proportion of carbonate of lime and a little cholesterine: the nucleus is loose and has been divided.

Presented by Sir William Blizard, 1822.

A 104. A large oval calculus consisting of cholesterine mixed, especially at its exterior, with the colouring matter of the bile. *Hunterian.*

A 105. Numerous small polygonal-shaped calculi consisting of impure cholesterine taken from one gall-bladder. *Hunterian.*

A 106. A similar series. *Hunterian.*

A 107. A similar series. *Hunterian.*

A 108. A small broken calculus consisting of nearly pure cholesterine surrounding a dark-coloured friable nucleus composed chiefly of the colouring matter of the bile. *Hunterian.*

A 109. A small oval gall-stone broken across; it consists of crystallized cholesterine. *Hunterian.*

A 110. Five small dark-coloured calculi composed of impure cholesterine.

Hunterian.

A 111. A biliary calculus the surface of which is crystalline; it consists of nearly pure cholesterine. *Hunterian.*

A 112. Two small angularly-shaped biliary calculi consisting of impure cholesterine deeply stained by the colouring matter of the bile.

British Museum.

A 113. Four small "human gall-stones," consisting of impure cholesterine coated by the colouring matter of the bile, with some carbonate of lime.
Presented by Everard Home, Esq., 1807.

A 114. A large cylindrical calculus consisting of cholesterine and the colouring matter of the bile. Taken from the gall-bladder of an old woman.
Presented by J. D. Hudson, Esq., 1842.

A 115. A section of a small cylindrical calculus composed of impure cholesterine. *Presented by W. T. Brande, Esq.*, 1841.

A 116. Fragments of three small impure cholesterine calculi.
Presented by Sir William Blizard, 1822.

A 117. A large oval calculus tuberculated on its exterior, consisting of nearly pure cholesterine. *Mus. Taunton.*

A 118. A small cholesterine calculus. *Hunterian.*

A 119. A tuberculated cholesterine calculus. *Hunterian.*

A 120. Seven irregularly-shaped cholesterine concretions taken from the gall-bladder of an old woman, whose liver and lungs were studded with deposits of a yellow matter resembling gelatinous carcinoma. The glands in the mesentery and in the posterior mediastinum were converted into the same carcinomatous-looking matter, and the former constituted a large tumour on the right side of the abdomen ; a similar deposit had also taken place in the submucous tissue of the gall-bladder. The patient suffered from pyrosis for the last thirty years of her life, and a recent ulcer, together with the cicatrices of several others, were visible on the internal lining of the stomach. Her appetite was good, and the evacuations were natural. Some years before death a tumour was removed from the front of the tibia, which was pronounced to be true cancer.

The gall-bladder contained a small quantity of a sero-purulent fluid, apparently unmixed with bile ; it is preserved, with a portion of the liver, among the pathological preparations.

Presented by Thomas Taylor, Esq., 1843.

A 121. Seven small cholesterine calculi, having the following memorandum in

the Sloanian MS. Catalogue :—" Calculi 120 ex vesicâ felleâ Equitis Roberti Jawdie de Claxton desumpti præter 30 aut 40 deperditos 1638. Item calculi fellei duo per sedem ejecti a Dominâ Holt de Tharton quæ postea a sæpius recurrente ictero convaluit 1648.—Sir Thomas Brown."

British Museum.

A 122. A small oval calculus, composed of cholesterine slightly tinged with the colouring matter of the bile. *Hunterian.*

A 123. Fragments and the powder of " a cluster of four gall-stones taken from a lady :" these concretions appear to have contained some animal matter, perhaps inspissated bile, which has been devoured by Dermestes, causing them to fall to pieces. They consist of cholesterine mixed with a very large proportion of the colouring matter of the bile.

Presented by Everard Home, Esq., 1807.

A 124. A large biliary calculus, the exterior of which has fallen to pieces ; it was accompanied by the following history :—" Lawrence, Sexagenaria. Post enormes vomitus fœtidissimos (quos sæpe antea experta fuerat) et acutas dolores lateris, hic calculus exiit cum fæcibus 5 Dec. 1785, â omnium symptomatum fugâ, excepta quædam hypochondrii indolescentia, et tum pendebat ʒi gr. xxiiiss." *Presented by Everard Home, Esq.*

A 125. Seven polygonal-shaped calculi, consisting of impure cholesterine, taken from one gall-bladder. *Hunterian.*

A 126.
A 127.
A 128.
A 129.
A 130.
} Gall-bladders containing biliary concretions. *Hunterian.*

A 131. A gall-bladder the cavity of which is almost entirely filled by a large cholesterine calculus. *Hunterian.*

A 132. Three cholesterine calculi, which fill the entire cavity of a gall-bladder. They have been divided and are held together by the dried bladder.

Presented by Dr. J. Power, 1821.

A 133. A gall-bladder completely filled by four or five of the ordinary cholesterine concretions. *Mus. Howship.*

CALCULI CONSISTING PRINCIPALLY OF THE COLOURING MATTER OF THE BILE, CHOLEPYRRHINE (*Berzelius*), OR OF SUBSTANCES ALLIED TO IT.

It has been already remarked that the colouring matter of the bile very rarely forms an entire calculus in the human gall-bladder, although it is generally present in cholesterine calculi. The following calculi, though probably many of them were taken from the Ox, were arranged by Mr. Hunter among the human concretions, in which place they are retained, as similar concretions have been examined by Dr. Prout which were undoubtedly of human origin. In their chemical and general characters these concretions differ in no respect from those found in the gall-bladder of oxen; their description will therefore be included in the preface to the catalogue of the biliary concretions from the lower animals.

𝔅. *Var. α. Colouring Matter of the Bile.*

𝔅 α 1. Three small angularly-shaped biliary calculi with two broken masses of the same. They are composed of concentric laminæ of the colouring matter of the bile, mixed with mucus of the gall-bladder, a little inspissated bile and a trace of fatty matter, but they do not contain any cholesterine. *Hunterian.*

𝔅 α 2. Three similar calculi having a tetrahedric figure. *Hunterian.*

𝔅 α 3. Several oval and angularly-shaped calculi, composed almost wholly of the colouring matter of the bile. *Hunterian.*

𝔅 α 4. Fragments of three angularly-shaped calculi similar in composition to the preceding. *Hunterian.*

𝔅 α 5. Fragments of a similar calculus, stated to have been taken from the human gall-bladder. *British Museum.*

𝔅 α 6. Several broken calculi, composed almost entirely of the colouring matter of the bile. *Hunterian.*

𝔅 α 7. A large oval calculus consisting of the brown colouring matter of the bile. *Hunterian.*

𝔅 α 8. An oval calculus, having an angular surface; similar in composition to the preceding. *Hunterian.*

𝔅. *Var. β. Substance allied to the Colouring Matter of the Bile.*

The concretions included in this variety, although possessing the general chemical characters of the colouring matter of the bile, yet differ from it in so many particulars, that they must be regarded as containing a peculiar substance, the existence of which has not been hitherto noticed; only in Nos. 1 and 2 of the following calculi does this substance occur in a state of tolerable purity, in all the others it is mixed with the colouring matter of the bile. These concretions are not very uncommon in the human subject; they have not been found in the lower animals, and are probably identical with those frequently described as consisting of inspissated bile. They are distinguished in their external characters from calculi composed of the colouring matter of the bile by their deep black colour and shining lustre, by not being made up of concentric layers, but consisting of a homogeneous mass resembling in lustre, fracture, &c., a mass of pitch. They usually assume the form of small wrinkled grains, but are sometimes found of an oval figure with a rough external surface. (Vide Plate XVII. fig. 9.)

These calculi dissolve for the most part in solution of potass; the solution is of a brownish-red colour: muriatic acid throws down from it a dirty brown flocculent precipitate, which dissolves in solution of ammonia with a pinkish-red tint, and is again precipitated on the addition of an acid; when muriate of baryta is added to the ammoniacal solution a light brown precipitate falls. When heated on platina foil they emit an offensive odour; do not fuse, but catch fire, burn for a short time, and leave an abundant carbonaceous ash, which frequently contains the carbonates of lime and soda. The greater part of the lime is in chemical combination with the organic matter, as the calculus only partially dissolves in solution of potass, unless previously digested in an acid, when the lime is removed and the residue wholly dissolves in the alkaline liquor. They are insoluble in water, and very sparingly so in alcohol, æther and solution of ammonia.

𝔅 β 1. A broken biliary calculus the exterior of which is of a dark colour and very rough. It consists principally of the peculiar colouring matter above described, and contains carbonate of lime with the mucus of the gall-bladder. The nucleus does not fill the entire cavity of the calculus; it is of a deep black colour with a resinous lustre and fracture; its composition is similar to the exterior, and resembles a small mass of pitch. *Hunterian.*

𝔅 β 2. Several small irregularly-shaped masses of biliary concrete. They possess a black colour with a resinous lustre, and are similar in composition to the preceding. *Hunterian.*

𝔅 β 3. Several small irregularly-shaped masses of biliary concrete of a black colour, and having a resinous lustre. Composition similar to the preceding. *Hunterian.*

𝔅 β 4. Four irregularly-shaped calculi, resembling Cannel-coal in fracture and colour. Composition similar to the preceding. *Hunterian.*

𝔅 β 5. Several small round biliary calculi, of a dark brown, almost a black colour. They consist of the peculiar matter above described mixed with the brown colouring matter of the bile. *Hunterian.*

𝔅 β 6. A small mulberry-shaped calculus, taken from the gall-bladder of a seaman who was executed for murder. It is of a very dark colour, but not so shining as the specimens Nos. 1 and 2, and it contains in addition to their constituents a considerable proportion of the brown colouring matter of the bile. *Presented by William Clift, Esq.*, 1816.

𝔅 β 7. Biliary concrete in the form of small grains. Composition similar to No. 5. *Hunterian.*

𝔅 β 8. Small fragments of biliary concrete, apparently similar in composition to the former. *Hunterian.*

𝔅 β 9. The same. *Hunterian.*

𝔅 β 10. Fragments of biliary calculi, consisting of the same black matter mixed

with a large quantity of the brown colouring matter of the bile, carbonate of soda and earthy matter. *Hunterian.*

𝔅 β 11. A similar specimen. *Hunterian.*

𝔅 β 12. Several small wrinkled calculi of a deep black colour. They are composed of the peculiar matter above described mixed with the brown colouring matter of the bile, lime and mucus of the gall-bladder. *Mus. Howship.*

CALCULI CONSISTING PRINCIPALLY OF THE FATTY ACIDS (STEARIC, OLEIC OR MARGARIC ACID).

In the bile of most species of animals, small quantities of oleic, margaric and stearic acids are to be found in combination with soda. The only instance, however, of these acids forming a biliary concretion, was discovered in this collection in a calculus which was placed by Mr. Hunter among the human urinary concretions, and was supposed to consist of the earthy phosphates. It was unaccompanied by any history, and it must therefore remain doubtful whether it was taken from the human subject or from one of the lower animals. As the fatty acids, however, in their ultimate composition bear a much greater analogy to cholesterine, the principal constituent of human concretions, than they do to the colouring matter of the bile, and as biliary calculi, with the exception of those from oxen, are very uncommon in the lower animals, this calculus is allowed to remain with the human concretions.

This calculus was of a dirty white colour, and had the greasy feel of cholesterine calculi; it floated on water, and when applied to the tongue, left an impression of bitterness. It was of an oval figure slightly flattened, one inch and a half in length, rather better than an inch in thickness, and about one inch and a quarter in breadth. It readily yielded to the knife, and the cut surface presented a polished appearance; its structure was lamellar, being composed of white and reddish-yellow layers arranged concentrically and alternating with each other. The layers were easily separable: at its centre there was a small vacuity.

When heated before the blowpipe it readily fused, then caught fire, burning

with a clear flame and giving out the smell of animal matter, but nothing of a urinous character. It left a carbonaceous residue, which by raising the heat was converted into a white ash. This ash was alkaline, dissolved in water and dilute acetic acid, and the solutions gave a white precipitate with oxalate of ammonia; it was therefore lime.

When digested in boiling water, the water became slightly brown, and on evaporation a transparent yellowish-brown residue was left, which had a bitter taste and consisted of inspissated bile.

Boiling alcohol extracted from it only a minute quantity of white fatty matter, which was deposited on cooling.

A solution of caustic potass removed the whole of the colouring matter, but the rest of the calculus was unacted on: the potass solution was dirty green, and when neutralized with muriatic acid deposited a scanty precipitate having the same tint.

When digested in nitric acid, effervescence took place, with the escape of a little nitrous acid; it then melted into a transparent oil, which on cooling concreted into a white fatty matter. This substance, when washed with distilled water, melted at a temperature much below that of boiling water.

When, instead of nitric acid, muriatic or acetic acid was employed, the portion of calculus did not melt until it had been removed from the acid; it then presented similar appearances to that obtained by the action of nitric acid; consequently this white fatty matter was not formed by the action of the nitric acid.

In all these cases the acids retained lime in solution. The fatty matter separated by the action of acids was partially soluble in boiling alcohol, and the solution on cooling deposited shining crystalline scales. With caustic potass it formed a ropy almost gelatinous solution, and was precipitated in white flakes on the addition of an acid. A small piece being placed upon the ball of a thermometer previously heated, began to solidify when the temperature had sunk to about 135° Fahr.

From these experiments there could be no doubt that this calculus consisted of margarate, or stearate of lime, mixed probably with the oleate of the same base and some of the other constituents of the bile. That the lime was in combination with the fatty acid, was indicated by the insolubility of the calculus either

in alcohol or caustic alkaline solutions, until it had been previously digested in an acid.

To determine whether one or more of the fatty acids were present, the following analysis was made.

12·80 grs. of the calculus previously dried *in vacuo* over sulphuric acid were boiled in distilled water: a peculiar odour was given off, and the water acquired a yellowish-brown colour: being evaporated to dryness it left a transparent resinous-looking residue, which weighed 0·84. This residue when digested in alcohol left 0·24 in the form of dirty yellow flakes, which in distilled water swelled up and ultimately dissolved, forming an imperfect solution which in its chemical characters exactly resembled that of the mucus of the gall-bladder.

The alcoholic solution being evaporated to dryness, the residue was redissolved in water; the solution was intensely bitter; with muriatic acid it gave a copious viscid precipitate; acetate of lead produced likewise a viscid precipitate, and the supernatant liquor when clear was again troubled by a solution of subacetate of lead.

The 0·84 consisted therefore of mucus of the gall-bladder 0·24; inspissated bile 0·60.

After water had extracted from the calculus all that it was capable of dissolving, it was treated with successive portions of boiling alcohol sp. gr. ·830.

The first alcoholic solution on cooling deposited a white matter, which did not readily redissolve in hot alcohol or æther, but was acted upon by acetic acid. It appeared to be part of the calculus that had been dissolved unchanged; the quantity was however too minute to be estimated. The alcoholic solutions were filtered, and being mixed together, the whole was gently evaporated; as the liquid became concentrated, it deposited some white fatty matter and acquired a yellow tinge; a residuum was ultimately left, which had the appearance of a mixture of a fluid and a concrete oleaginous substance. On the application of heat it became a yellow oil, which on cooling only partially solidified; it weighed 0·47. This matter strongly reddened litmus paper; dissolved readily in a cold solution of caustic potass; and was precipitated in soft flakes on the addition of an acid. It consisted therefore of oleic acid, mixed with margaric or stearic acid.

Strong acetic acid diluted with twice its bulk of water was now poured over

the calculus, and the action of the acid aided by a gentle heat. The insoluble residue was collected on double filters, washed, and dried.

The acetic solution with its washings was reduced to a small bulk, and a solution of ammonia added; after the lapse of several hours no precipitate appearing, the excess of ammonia was nearly neutralized by a solution of oxalic acid: a white precipitate fell, which when washed, dried, and heated to dull redness in a platina crucible, left 2·09 carbonate of lime = 1·17 lime.

The remaining liquid being evaporated to dryness and the ammoniacal salts expelled, a residuum was left which weighed 0·10: water dissolved a portion of this; the solution was alkaline, and when evaporated minute crystals were formed, which slightly effervesced in acetic acid: their solution not precipitating chloride of platina, leaves little doubt of their being carbonate of soda: the small portion which remained undissolved proved to be carbonate of lime.

The matter left upon the filter after the action of the acetic acid was again digested in boiling alcohol, a considerable portion dissolved, and the remainder had acquired a much deeper colour: it was collected on the same filters, which were repeatedly washed with boiling spirit; when dried and weighed it amounted to 0·86.

This substance possessed a brownish-yellow colour. It dissolved in solutions of caustic and carbonate of potass, forming solutions having nearly the same tint.

Muriatic acid rendered it green, and when added to its alkaline solution threw down green flocks.

With nitric acid it formed a red solution.

This substance was therefore identical with the colouring matter of the bile.

The alcoholic solutions were concentrated by careful distillation in a small retort: the liquid remaining in the retort, when cold, formed a soft crystalline mass, composed of brilliant plates and having a pearly lustre, very much resembling margaric acid.

The crystalline matter, when fused and kept for some time *in vacuo* over sulphuric acid, weighed 8·88. It melted at 136° Fahr., and on cooling became a crystalline solid, which reddened litmus paper, and was easily soluble in a cold solution of caustic potass; the solution when concentrated was ropy and gelatinous; when dilute it formed a slightly milky mixture with minute glistening particles

floating in it; on the addition of an acid, the substance was thrown down in the form of white flakes, which possessed the same properties as before solution. When boiled with the alkaline carbonates, it was dissolved, with the escape of carbonic acid. By redissolving it in hot alcohol, crystalline plates were deposited on cooling, which after washing with cold spirit fused at about 140°. The low fusing-point of this substance evidently indicated the presence of oleic acid. In order to ascertain whether the crystals fusible at 140° were pure margaric acid or stearic acid rendered more fusible by an admixture of oleic acid, they were again dissolved in warm spirit, and the crystals as soon as formed dried by compression between folds of blotting-paper; by repeating this process two or three times, the fusing-point was raised to nearly 160°. These crystals must therefore be regarded as pure stearic acid; and as it was found that both stearic and margaric acids require to be several times recrystallized from their alcoholic solutions to free them from even small quantities of oleic acid, and as no decided indication of the presence of margaric acid could be detected in the mother liquors, it is probable that only oleic acid had been separated by the above treatment, and that consequently margaric acid did not enter into the composition of the calculus. It would however be impossible to speak decidedly on this point.

The result of the analysis is as follows:—

Stearic acid mixed with a small proportion of oleic acid	9·35
Lime	1·17
Soda with a trace of lime	0·05
Yellow colouring matter of the bile	0·86
Inspissated bile	0·60
Mucus of the gall-bladder	0·24
	12·27
Loss	53*
	12·80

ℭ. *Stearate and Oleate of Lime*

ℭ 1. A section of the biliary calculus, the analysis of which is given above. (Vide Plate XVII. fig. 1.)

* The greater part of the loss in this analysis should be added to the stearic acid, as owing to the sudden extrication of vapour while under the receiver of the air-pump a small part of the acid was thrown out.

CALCULI CONSISTING PRINCIPALLY OF CARBONATE OF LIME.

Carbonate of lime is very frequently found in small quantities in biliary concretions. The most remarkable and probably the first instance of this salt forming an entire biliary calculus, was described by Dr. Marcet in his 'Essay on Calculous Disorders.' This concretion consisted wholly of carbonate of lime tinged by bile. It was of a bright yellow colour, heavier than water, and measured $2\frac{5}{8}$ inches in length and $2\frac{1}{4}$ inches in its largest circumference. It was taken by Mr. Green from the gall-bladder of a body in the dissecting-room of St. Thomas's Hospital.

MM. Bally and Henry* also found a gall-stone from the human subject to consist of 72·70 per cent. of carbonate of lime, with a trace of carbonate of magnesia, and 13·51 of phosphate of lime.

𝔇. *Carbonate of Lime.*

𝔇 1. A small oval calculus of a dark brown colour divided transversely. This calculus contains nearly 70 per cent. of carbonate of lime, with a trace of phosphate of lime and carbonate of magnesia; the remainder consists of the brown colouring matter of the bile. (Vide Plate XVII. fig. 13.)
Hunterian.

𝔇 2. Eight small concretions consisting of carbonate of lime, deposited upon a nucleus of the colouring matter of the bile. "From the human gall-bladder."
Hunterian.

FROM THE SALIVARY ORGANS.

CALCULI CONSISTING OF PHOSPHATE, WITH CARBONATE OF LIME.

The concretions which form in the salivary glands and passages aresimilar in composition to those from the prostate gland, being always composed of phosphate of lime, mixed with variable quantities of carbonate of lime and animal matter. With the exception of containing a greater number of epithelial scales, their animal matter when examined by the microscope presents similar appearances to that of urinary calculi. Salivary calculi seldom possess a regularly

* Simon, *Handbuch der Medizinischen Chemie*, ii. p. 569.

laminated structure; they are of a white colour, and extremely hard; their external surface is usually rough, sometimes tuberculated; when heated before the blowpipe they char, and emit a very fœtid odour of burning animal matter. The composition of these concretions was first pointed out by Dr. Wollaston. A specimen analysed by Lecanu gave phosphate of lime 75, carbonate of lime 20, animal matter and loss 5*.

G. *Phosphate, with Carbonate of Lime.*

G 1. A submaxillary calculus, composed of phosphate of lime with a trace of carbonate of lime and animal matter. This calculus was described in the Sloanian MS. Catalogue as "an oblong rugged stone, taken out of the ranula under the right side of the tongue of Foulk Williams. There was some part cutt to make way: it was extreme fetid: had been twelve years breeding: some pain at first coming." *British Museum.*

G 2. A small calculus, "from Mr. Chauney."—Sloanian MS. Catalogue. It consists principally of phosphate of lime, and has probably been taken from one of the salivary ducts. *British Museum.*

G 3. An oval-shaped concretion, similar in composition to the preceding specimens. "From the duct of the maxillary gland." *Hunterian.*

G 4. A large submaxillary calculus of a flattened pyriform figure. It measures one inch and a half in length and three quarters of an inch in breadth. "Formed under the tongue of Richard Dyche. He was a very old man, and was conceived to be dying, being nearly choaked by the tumour, when in consequence of an effort the calculus was thrown out, and he recovered." Phosphate with a little carbonate of lime and animal matter.
Presented by James Moore, Esq.

G 5. A small submaxillary concretion, divided transversely. Described in the Sloanian MS. Catalogue as "a stone from the tongue, and which occasioned a quincy to a coachman in Great Russell Street." Phosphate of lime. *British Museum.*

G 6. A small oblong calculus, consisting principally of phosphate of lime. "From the sublingual gland: formed in twelve days." *Hunterian.*

* *Journ. de Pharm.*, xiii. 626.

G 7. Fragments of a salivary concretion, taken from the parotid gland of a woman about forty years of age.

Presented by James Briggs, Esq., 1832.

G 8. Small earthy concretions, consisting chiefly of phosphate of lime. "From the tonsils." *Hunterian.*

FROM THE STOMACH AND INTESTINES.

INTRODUCTION.

Intestinal concretions are of rare occurrence in the human subject, and owe their formation to accidental circumstances; the greater number of them being composed merely of substances which have been received with the food into the alimentary canal. The crystalline phosphates of magnesia and lime, which form the most common species of intestinal calculus from the lower animals, scarcely, if ever, constitute an entire calculus in the human intestine, although these earthy salts are generally present in the oat-hair concretions. Indeed, the only kind of intestinal concretion to which man can be said to be liable is the oat-hair concretion described by Dr. Wollaston, and this only occurs in persons who live chiefly upon undressed oatmeal.

Fatty concretions have been described by MM. Lassaigne*, Colombot and Caventou as occurring in the human subject. Those examined by the last-named chemist were translucent and of a light green colour. They readily dissolved in alcohol, but left behind an animal matter consisting of thin vesicles in which the fatty matter had been contained†. In this Museum there are three small calculi possessing similar characters. Their exterior consists of a thick brown membranous coat; internally they are soft, and have the appearance of rancid fat. When digested in alcohol the fatty matter dissolved, and the insoluble residue, examined by the microscope, was seen to consist of transparent vesicles precisely similar to those of adipose tissue. It is therefore probable that they were nothing more than rolled masses of undigested fat.

Various other substances have been met with in the human intestines, in

* *Journ. de Chimie Médicale*, i. 119.

† *Journ. de Pharm.* xv. 72.

some instances causing death by the obstruction they offered; these can however be scarcely termed calculi, since they are merely amorphous masses of various ingesta, which the bowel, from weakness or disease, has been unable to expel. Such are the masses of carbonate of magnesia described by Mr. Brande as being found in the colon of a lady who had taken large quantities of magnesia.

The human intestinal concretions are divided into the following classes. The figures indicate the number of specimens belonging to each variety at present in the Museum.

ℌ.	Calculi consisting principally of animal hairs	1.
ℑ.	vegetable hairs	18.
ℜ.	various amorphous substances	2.

CONCRETIONS CONSISTING OF ANIMAL HAIRS.

ℌ. *Hair-balls.*

ℌ 1. Three balls of human hair. The smallest was voided per anum. The two larger were taken from the stomach. The following history of the case, by William Wood, Esq., is abridged from the eighth volume of 'Medical Facts and Observations.' Mary Spain, aged 22, enjoyed good health until 18 years of age, when she became chlorotic; had frequent vomiting, constipation, and pains in the abdomen resembling labour pains. These symptoms returned every three or four months. About three weeks before her death, she voided a small mass of hair. On opening the abdomen two large masses of hair were found in the stomach, and a quantity of dark-coloured fluid in the peritonæum. The hair weighed when dry above ten ounces and a half; it resembled that on her head, which her friends had remarked had become of late very short, although no one had ever seen her swallow any*. *Mus. Heaviside.*

CONCRETIONS CONSISTING PRINCIPALLY OF VEGETABLE HAIRS.

The concretions found in the large intestines of the human subject are generally composed of the small hairs which are attached to the summit of the

* A similar case occurring in a boy is recorded in the London Medical Journal, vol. iv. p. 361.

oat-seed (*Avena sativa*). They are not, however, of very common occurrence, being for the most part confined to the labouring classes of Scotland and some of the northern counties of England, where oatmeal forms a large portion of their daily food.

These concretions are irregular in form and size. They are frequently as large as the fist, and are of a dirty-white or light brown colour. Their external surface is smooth, and they are exceedingly light. When divided they are found to consist of concentric layers of a fibrous substance closely felted together having a velvety feel, between which are often to be observed thin white layers consisting of the earthy phosphates. A piece of bone, a plum- or cherry-stone usually constitutes their nucleus.

Dr. Monro, whose father had made a large collection of these calculi, has given an elaborate history of them in his 'Morbid Anatomy of the Gullet.' We are informed by him that they were considered by Morgagni as similar in composition to biliary concretions, while others, as Van Swieten, Richerand and Callisen, were of opinion that they consisted simply of indurated fæces. These calculi were analysed by Cadet without success, and also by Dr. Thomson, who detected in them small quantities of various saline and earthy substances, but was unable to determine the nature of the vegetable matter which constituted the bulk of the calculus and gave to it its peculiar characters. Their composition remained unexplained until one of the concretions was shown to Dr. Wollaston, who "found the velvety substance to consist of extremely minute vegetable fibres or short needles pointed at both ends, which he immediately conjectured to arise from some kind of food peculiar to Scotland. For some time however he failed in his attempts to trace this substance to its origin. But the ingenious Mr. Clift, of the College of Surgeons, to whom the subject was mentioned in conversation, having put the question, whether this fibrous substance might not proceed from oats, Dr. Wollaston was induced to examine the structure of this seed, and the result fully verified Mr. Clift's conjecture. If the oat-seed be denuded of its husk, minute needles or beards forming a small brush are seen planted at one of its ends. Dr. Wollaston, on examining these needles and comparing them with similar ones detached from the calculi and forming the velvety substance in question, satisfied himself of their perfect identity*."

* Marcet's Essay on Calculous Disorders, 1819, p. 139.

Since this discovery by Dr. Wollaston, the oat-hair calculus has been examined by Mr. Children and by many other chemists, also lately by Dr. D. Maclagan, whose analysis is subjoined, as it furnishes a good example of the various substances which enter into the composition of these concretions*. Among the vegetable hairs which constituted the fibrous matter of the calculus, Dr. Maclagan detected portions of the paleæ, and other parts of the husk of the seed. The oat-seed and its hairs magnified, together with a figure of one of the calculi, is given in Plate XVI. fig. 6.

J. *Oat-hair Concretions.*

J 1. Three large irregularly-shaped concretions and a portion of a fourth, consisting of the setæ on the oat-seed, with layers of the earthy phosphates.

An account of this case with an analysis of the concretions is published by Mr. Children in the Transactions of the Royal Society for 1822, from which the following has been abridged. John Chambers, aged 19, a carpenter at Clitheroe in Lancashire, was in the habit, during the hot weather of July 1814, of eating a quantity of unripe plums, usually swallowing the stones at the same time, under the notion entertained by the lower classes in that neighbourhood that they would assist the digestion of the fruit. About eight months afterwards he applied to Mr. Coultate for advice, complaining of pain in the abdomen attended with diarrhœa. His abdomen was found to be tense, but not much enlarged. When in the workshop he used to lean against the bench, pressing his stomach hard against it, which he said afforded him great relief; medicines of an astringent nature were first prescribed, which seemed for a time to be of service, but the diarrhœa increased, with emaciation, and a hard circumscribed tumour was discovered on one side of the abdomen. The patient daily became more emaciated, and in about three months he died. His appetite was voracious, to within a short time of his death. He always felt himself worse after meals. His stools, especially for some weeks before he expired, were like blood and water.

* Water 10, albumen 2, fæcal matter 6, soluble vegetable matter 8, lactate of soda 2, salts, muriates and sulphates 2, fatty matter and stearic acid 8, phosphate of lime with traces of sulphate 20, fibrous matter 36, silica 6. London and Edinburgh Monthly Journal, 1841, p. 646.

On opening the body, the three concretions were found in the arch of the colon, closely compacted together. The coats of the intestine were much thickened, and formed into a sort of pouch, where the concretions lay. The other viscera were healthy. One of the concretions was divided and found to contain a plum-stone.

Chambers's usual diet was milk porridge twice a day, viz. at breakfast and supper; the milk thickened with oatmeal. His dinner commonly consisted of meat and potatoes, with oat-cake. In the afternoon he ate oat-bread and cheese, so that he never took a repast without oatmeal in some form.

The largest of these calculi weighed 1036 grs.; the smallest rather more than 511 grs. The specific gravity of the largest was 1·875 at 60° Fahr.

By the successive action of cold and hot water, alcohol, a dilute solution of caustic soda and of muriatic acid, Mr. Children found a hundred grains of one of these concretions to consist of—

Animal matter, chiefly gelatine	25·20
Resin	3·90
Phosphate of magnesia and ammonia . . .	5·16
Phosphate of lime	45·34
Vegetable fibre	20·30
	99·90

ℐ 2. Two large irregularly-shaped oat-hair concretions, having the following history in the Sloanian MS. Catalogue :—" Taken from the rectum of a woman at Romford, the history of which is given by George Thompson, M.D., in the appendix to a book called 'Galenopale,' printed in London, 1665, 8vo. Litho Colon." Each of these specimens is made up of two concretions cemented together by an external crust, consisting of the carbonates of lime and magnesia. *British Museum.*

ℐ 3. A similar specimen divided longitudinally, having apparently a small seed for its nucleus; it was extracted from the rectum of a young man 26 years of age by Dr. Webster, in 1783: the patient had voided before several smaller concretions of a similar character.

Presented by Dr. Babington, 1822.

J 4. Three oat-hair concretions, which were extracted from the rectum of a boy in Lancashire by Mr. Barlow.

Presented by — Barlow, Esq., 1821.

J 5. Three similar concretions, extracted by Mr. Barlow from the rectum of a girl. The setæ of the oat, of which they are principally composed, have accumulated around plum-stones, and they are coated in parts by a white crust, consisting of phosphate of lime with a little phosphate of magnesia and ammonia. *Presented by — Barlow, Esq.*, 1821.

J 6. An intestinal concretion, similar in composition to the preceding, divided longitudinally. *Presented by Sir A. Cooper*, 1821.

J 7. "A ball or bezoar taken out of the guts of a schoolmaster in Lancashire, who suffered seven years of the colic by it (notwithstanding the attempts of physicians). The centre is a plumb-stone stuck there, which gathered *tomentum* about it, which was found in opening his body, by his own direction, after death, to find out the cause of so great a distemper. Bought of Dr. Leigh."—*Sloanian MS. Catalogue.* It is one of the ordinary oat-hair concretions. *British Museum*, 1821.

J 8. An oat-hair concretion of a nearly spherical shape, measuring two inches in diameter. "This stone was extracted in 1717 from the rectum of a Cumberland labourer; he had been puny and consumptive for five or six years previously, but after its extraction he became strong, fleshy and well." Its nucleus is a plum-stone, and it is coated by a thin earthy crust. *British Museum.*

J 9. A small intestinal concretion from the human subject, having a plum-stone for its nucleus. *British Museum.*

J 10. A similar specimen, being "one of many balls found in the intestinum ileum of a man in St. Bartholomew's Hospital, who was thought to have the stone. From Mr. Dobbins."—*Sloanian MS. Catalogue.*

British Museum.

J 11. Human intestinal concretion, composed of the setæ on the oat-seed. It has a plum-stone for its nucleus. *British Museum.*

J 12. A globular intestinal concretion, similar in composition to the preceding specimen, but coated by a thin crust, consisting principally of phosphate of lime. *British Museum.*

J 13. A large and very irregularly-shaped concretion, similar in appearance and composition to the preceding specimen. *British Museum.*

J 14. A small irregularly-shaped concretion, consisting of the fine hairs on the seed of the oat. It is probably from the human subject, and has a plum-stone for its nucleus. *Leverian Museum.*

J 15. Oat-hair concretion, of a rude triangular figure. It has the following history in the Sloanian MS. Catalogue :—"A stone which was drawn out of a woman's anus nigh this place. She had been afflicted with colic pains for some years before the stone was taken from her to that degree that she was perfectly emaciated. She has ever since enjoyed perfect health, and is now about fifty years old.—Dr. Richardson, near Bradford, Yorkshire." *British Museum.*

J 16. A flattened circular concretion and another of a rude triangular figure, described in the Sloanian MS. Catalogue as "Stones brought away from a smith by stool with Elixir Salutis, by Dr. Darcy, after many months or years colic pains." They consist of the ordinary oat concretion, and are coated by a thin, smooth layer of phosphate of lime.
British Museum.

J 17. An oat-hair intestinal concretion from the human subject, of a rude triangular figure. *Mus. Liston.*

CONCRETIONS CONSISTING OF VARIOUS SUBSTANCES.

K 1. Several amorphous, earthy-looking masses of a yellowish red colour, which were taken from the appendix cæci of Colonel Dalrymple. They acquire a slight waxy lustre by friction, and are composed of peroxide of iron, fatty matter, stearate or margarate of lime, with portions of vegetable fibre and a little phosphate of lime.

The following history of the case is taken from the MS. of Mr. Hunter :

" I opened Colonel Dalrymple, who died of an inflammation of his bowels, joined with a total stoppage of his stools. He did not go to stool from Tuesday to the Tuesday following, when he died. The physic he took never passed through him, nor did the clysters ever come away. In the meantime he had not starved himself, but had eaten moderately. He had great pain in his belly, and it was vastly tight.

" On opening the abdomen I found that the liver adhered pretty firmly to the muscles there, and also to the diaphragm. I likewise found that it adhered to the stomach by its left concave surface, and on the right to the pylorus, the beginning of the transverse arch of the colon, &c. These adhesions were strong and of old standing ; the gall-bladder was about half-full of bile, and its ducts were clear ; the epiploon sound but not large, so as to cover the intestines ; the small intestines towards the ilium adhered to one another and to parts adjacent, especially in the pelvis ; but this adhesion was of a soft, glutinous nature, which showed it to be recent, and a good many red spots on the surface of the peritonæum, especially on that surface that was in contact with the peritonæum of the abdomen. The appendix cæci was vastly large, and on squeezing the colon the air escaped through the coats of the appendix cæci ; it adhered to parts it came in contact with, and from it came about three ounces of a putrid matter which lay in the pelvis. On feeling the appendixc æci, I found hard bodies in it, which proved to be hard chalky fæces, some as large as a nut. On examining the inside of the intestines they seemed sound, excepting the appendix cæci, which was vastly inflamed, ulcerated, and in some places mortified. Near the termination of the ilium and the cæcum they seemed thicker in their coats than common, and appeared as if dropsical, and on wounding them I could easily squeeze out a clear water.

" There was a good deal of air in the stomach and the whole of the intestines, also a good deal of fluid, which was mixed with fæces in the colon. The fæces in the colon lay chiefly plaistered to the inside of the coats. The whole canal was clear. The reason for his want of stools must have arisen from a paralysis of the intestines, as no obstruction was

observable, even to the anus; and what strengthens this opinion is, that he did not make water, although there was water in the bladder, and still more strengthened by his losing in a small degree the use of his limbs."

The peroxide of iron was probably derived from the patient having taken carbonate of iron.

K 2. An oblong unlaminated mass, consisting principally of undigested oat-meal. It is evidently an intestinal concretion, and was placed by Mr. Hunter among those from the human subject, but has no history.

Hunterian.

K 3. Three small rounded masses, consisting of fatty matter surrounded by a membranous coat.

Hunterian

Division II.

CALCULI FROM THE DIGESTIVE TRACT OF THE LOWER ANIMALS.

FROM THE BILIARY ORGANS.

CALCULI CONSISTING PRINCIPALLY OF THE COLOURING MATTER OF THE BILE. (MATIERE JAUNE DE LA BILE, *Thénard*: GALLENBRAUN, *Gmelin*: BILIPHAEIN, *Simon*: CHOLEPYRRHINE, *Berzelius.*)

The brown concretions which are sometimes found in the gall-bladder, and more rarely in the intestines of oxen, are composed almost wholly of the peculiar matter to which the above terms have been applied.

These concretions have been known for a very considerable period, probably long before biliary calculi had been discovered in the human subject. They are of a rich reddish-brown colour, and are sometimes employed by artists, although the colour is not permanent. They are exceedingly light and friable, and readily separate into concentric layers. They vary in size from that of a pea to that of a hen's egg, and are usually of an ovoid figure, but when two or more calculi are contained in the gall-bladder, they often present a very regular cubic or tetrahedric figure. These calculi always possess a musky odour, which appears to be peculiar to the concretions from the Ox. When heated before the blow-pipe they do not fuse, but puff up, catch fire and burn for a short time; a bulky carbonaceous ash remains, which almost always contains the carbonates of lime and soda. They partially dissolve in a solution of caustic potass. The liquid is of a deep brownish-red colour, and when neutralized by muriatic acid lets fall a grass-green flocculent precipitate (the Biliverdin of Berzelius and Gallengrün of

Gmelin), which readily dissolves in a solution of ammonia with the same tint. The ammoniacal solution yields a green precipitate on the addition of muriate of baryta. When nitric acid is added to their potass solution, the liquid becomes first bluish, then violet, red, and lastly yellow. Calculi consisting of this substance usually contain mucus of the gall-bladder, bile, with phosphate and carbonate of lime and carbonate of soda.

The facility with which the colouring matter of the bile undergoes chemical changes, and the consequent difficulty of procuring it in a state of purity, have prevented chemists from ascertaining its ultimate composition. It belongs to the class of nitrogenous bodies, and apparently possesses the properties of a weak acid, since it is not only readily soluble in solutions of potass and soda, but forms insoluble compounds with the earthy bases. In many of these concretions it exists partly in combination with lime: the compound does not dissolve when the calculus is digested in a cold solution of potass, but if previously treated with muriatic acid the lime is abstracted, and the residue becomes wholly soluble in the alkaline solution. When separated as completely as possible from the other constituents of the calculus, the colouring matter of the bile is of a fine yellowish-red colour. It is tasteless and inodorous, very slightly soluble in water, alcohol, or in solution of ammonia; when moistened with the latter and exposed to the air it absorbs oxygen and becomes greenish. It dissolves with facility in solutions of potass and soda; the liquid is of a brownish-red colour, but absorbs oxygen from the air and becomes greenish. By solution in an alkaline liquid the colouring matter of the bile undergoes decomposition, and is converted into a substance termed *Gallengrün* by Gmelin, which is thrown down on the addition of an acid in the form of grass-green flocks. This property, together with the peculiar action of nitric acid, are quite characteristic of the colouring matter of the bile, and serve to indicate its presence in calculi, or in any organic fluid.

𝔐. *Colouring Matter of the Bile.*

𝔐 1. The half of a large oval calculus "taken out of an Ox's gall."—*Sloanian MS. Catalogue.* *British Museum.*

𝔐 2. A large oval calculus, another of a cubic figure, and a third of a regular

tetrahedric shape, having its solid angles truncated, which is figured in Plate XVII. From the gall-bladder of the Ox.

M 3. Two large calculi "taken out of the gall-bladder of an Ox."—*Sloanian MS. Catalogue.* One is of a tetrahedric figure, having its edges rounded; the other, which is of a very singular shape, is figured in Plate XVII. *British Museum.*

M 4. Fragments of calculi "ex cysti felleâ Bovinâ."—*Sloanian MS. Catalogue.* *British Museum.*

M 5. Fragments of a large calculus from the gall-bladder of an Ox. *British Museum.*

M 6. A small broken calculus, "ex felle Bovis."—*Sloanian MS. Catalogue.* *British Museum.*

M 7. A small irregularly-shaped calculus, described in the Sloanian MS. Catalogue as a "gall-stone found in an Ox's or Cow's gall by Mr. Millington the silk-dyer." *British Museum.*

M 8. Two broken calculi of an oval figure, which were "taken out of the gall-bladder of an Ox."—*Sloanian MS. Catalogue.* *British Museum.*

M 9. Calculi taken from the gall-bladder of a Cow.

FROM THE SALIVARY ORGANS.

The concretions which have been found in the salivary ducts of the Horse, Ass, Elephant and Cow, differ only in composition from those taken from Man, in containing a larger proportion of carbonate of lime. Lassaigne found the earthy components of one of these concretions to consist of carbonate of lime 84, phosphate of lime 3*; and a specimen analysed by Caventou consisted of carbonate of lime 91·6, phosphate of lime 4·48, with 3·6 of animal matter†. Mr. Morton, in his 'Essay on Calculous Concretions,' quotes a passage from the *Hippopathology* of Mr. Percivall, to the effect that salivary calculi very seldom occur in British veterinary practice; and he has given us the history of

* *Ann. de Chimie,* xix. 174.

† *Journ. de Pharmacie,* xi. 465.

a large calculus which was successfully removed by an Italian professor of veterinary medicine from the left cheek of a mare, and which was contained in a distinct sac communicating by a narrow canal with the duct of Steno.

There are no specimens of salivary calculi from the lower animals in this collection.

FROM THE STOMACH AND INTESTINES.

INTRODUCTION.

The history of intestinal concretions affords a remarkable instance of the tendency of the human mind to attribute miraculous curative powers to substances, the nature and origin of which are enveloped in mystery. These bodies, which modern science has shown to consist merely of the undigested and excrementitious parts of the food of different animals, were formerly termed Bezoars, and were regarded as precious and sovereign remedies for all kinds of disease, were supposed to possess the power of counteracting the effects of poison, and for many ages were held in so much esteem, that they were regarded as valuable and acceptable presents by the native princes of the East.

Although the increasing knowledge and experience of mankind have gradually dispelled such illusions, and stripped these worthless drugs of the reputation in which credulity or cunning had for so long a period enshrined them, the aid of chemistry is required to enable us to form a just estimate of their actual value; and it is remarkable, that the composition of the Oriental Bezoar, which gave value and currency to all the other varieties, has remained to the present time a matter of doubt and uncertainty.

The occasional presence of concretions in the alimentary canal of herbivorous animals must have been known from the earliest period in every part of the globe; it does not, however, appear that any particular value was set upon those taken from the animals inhabiting the colder regions, although they were frequently substituted for the more valued species obtained from animals of warmer climates.

The word Bezoar is of Eastern origin: but authors do not agree as to its exact etymology; some assert that it is derived from two Persian words signi-

fying the destroyer of poison, while others derive it from the Persian name of the wild goat in which the concretions were found *.

Bezoars were divided into two species, the Oriental and the Occidental. The former were brought from Persia, Tartary, and the province of Golconda, where they were found in the stomach of a species of wild goat common in the mountainous districts of those regions. The Occidental Bezoars were taken from a similar animal inhabiting Peru and the West Indies. The Oriental Bezoars were by far the most esteemed; Tavernier informs us that he gave 500 crowns † for a single specimen which he afterwards exchanged to advantage, and that they increased in value according to their size in the same manner as diamonds. For one weighing four ounces he received 2000 livres, or about 150*l.* sterling ‡. The Bezoars were frequently set in hoops of gold or silver, having a chain of the same metal attached by which they were suspended in the liquid to which it was desired they should impart their virtues. Kœmpfer asserts

* "Varias habet hic lapis appellationes: nam Arabibus *Hager* dicitur, Persis *Bezaar*, Indis *Bezar*, Græcis *Alexipharmicum*, Latinis *Contra venenum*, Hispanis *Piedra contra veneno y desmayos*, hoc est, Lapis venena et animi deliquia curans. Conradus Gesnerus in animalium quadrupedum historia de Capra montana agens, scribit, hoc vocabulum *Belzaar* Hebræum esse: nam *Bel* Hebraicâ linguâ dominum significare et *Zaar* venenum, quasi interpretareris dominum veneni: nec immeritò sane tale nomen obtinet, quandoquidem ita venenis resistit, ut illa extinguat et tollat, non secus ac illorum dominus. Hinc sit ut omnia medicamenta venenis resistentia *Bezaardica* per excellentiam nuncupentur." —*Op. Clusii*, fol. edit. 1605, p. 8.

Clusius derives the word from the Persian name of the animal in which the stone is found, an opinion which he appears to have taken from Christopher a Costa, whose writings were translated by Clusius, and are included in the Exoticorum, &c., vide p. 279. A similar derivation is also to be found in Gesner's 'Historia Aromatum': "Vocatur autem hic lapis *Pazar* a *Pazan*, id est hirco, cum Arabibus tum Persis et *Corasone* incolis: nos corrupto nomine *Bezar* atque Indi magis corruptè *Bazar* appellant, quasi dicas lapidem forensem: nam *Bazar* eorum linguâ forum est."—*Clusii Exoticorum* lib. i. p. 216. Dr. John Fryer is very positive on the subject, and says, "The Persians call this stone *Pahazar*, being a compound of *Pa* and *Hazar*, the first of which is *against*, the other is *Poison*, as much as if you should say in Greek *antidoton*, in English *Counter poison*."—*Fryer's Travels*, p. 238, 1698.

Kœmpfer also derives it from the word *Pasahr*, although he denies the compound signification of the word: "Lapis Bezoar Orientalis verus et pretiosus *Pasahr*, ex quo nobis vox Bezoar creata est. Sceptici nostri philosophi nomen petunt ab Hebræa *Bahal* quod dominum, et Persico *Sahr* quod venenum significat, et lapidem veneni domitorem vocant. Sed hæc ex similitudine vocabulorum efficta derivatio est."—*E. Kœmpfer's Amœnitatum Exoticarum &c.*, Fasciculus 2, 4to, 1712.

M. Daubenton in the 'Encyclopédie Méthodique' has adopted *Pazan*, the wild goat of Persia, as the word from which Bezoar is derived.

† About 120*l.*

‡ Tavernier, Six Voyages of, fol. 1677, Translation.

that in Persia he scarcely ever met with any person of consequence who did not possess one of these concretions, which was preserved with great care among his most valued treasures *. If any other proof were wanting of the esteem in which they were and perhaps are still held in Persia, it would be found in the fact, that among the presents sent to the Emperor Napoleon by the Shah of Persia were three Oriental Bezoars.

The composition of the Oriental and Occidental Bezoars has hitherto eluded the research of chemists, although they have been frequently submitted to analysis; neither has it been determined to what particular species of concretion these terms should be applied. From a careful examination of the specimens in this collection, corroborated by the general characters assigned to these calculi by Clusius, Tavernier, Kœmpfer, and other authors, it will be shown in a future part of this work that the true Oriental Bezoar consists of the insoluble organic acid which is deposited from an infusion of gall-nuts when exposed to the air, and to which Braconnot has given the name of *Ellagic acid* †.

The term Occidental Bezoar appears to have been applied by many authors indiscriminately to all concretions not possessing the obvious characters of the Oriental Bezoar. In the Sloanian and Hunterian MSS., several calculi consisting of the earthy phosphates and of vegetable hairs are thus named. Sufficient evidence will however, it is believed, be adduced to prove that the true Occidental Bezoar consists of a vegetable resin, identical in composition with the resinous matter which formed the principal constituent of a calculus examined by M. Goëbel, and to which he has given the name of *Lithofellinic acid*, on the supposition that the calculus examined by him had been taken from the gall-bladder of some foreign animal ‡. It is not however probable that the peculiar constituent of either the Oriental or the Occidental Bezoar was confined exclusively to the animals of one or the other hemisphere, since the resinous and bitter juices from which these concretions are formed exist in the plants of both divisions of the globe. That such was the case with the Occidental Bezoar, we have the direct statement of Kœmpfer, who says that it was found in the wild goats of Persia, and that it was termed *Lapis Bezoar Occidentalis* on account of its similarity to the concretions brought from Peru and the West

* *Amœnitatum Exoticarum* Fasc. 2.

† *Ann. de Chimie et de Physique*, ix. 187.

‡ *Ann. der Chemie und Pharm.* B. xxxix. 1841.

Indies *. In the Hunterian and Sloanian MS. Catalogues these concretions are described as "false West Indian Bezoars"; their beautifully-lamellar structure, and the peculiar characters of the resin of which they are composed, sufficiently attest their real origin.

It is not easy to determine at what period Bezoars were introduced as medicinal remedies, although there is no doubt that they were first employed by the Arabian physicians. No mention of them is to be found in the ancient Greek and Latin authors: Nicolaus Monardes informs us that their use was first recommended by Serapion, Avicenna, Averroes and Avenzoar, names which would carry us back to the beginning of the tenth century †. From the East the use of these bodies as a medicine gradually spread into Europe, where they enjoyed so much reputation that they gave the name of Bezoardics to a large class of pharmaceutical preparations supposed to be peculiarly efficacious in counteracting the effects of poison. These substances were usually of a cordial and tonic nature, although several, as the Bezoarticum Mercuriale, &c., must have been very active remedies. A severe blow was dealt to the reputation of the Bezoar as an antidote to poison by the experiment of Ambrose Paré, who administered it to a criminal condemned to death, and to whom arsenic had been previously given, with what result it is scarcely necessary to add. As a pharmaceutical agent, however, it continued to be employed in combination with other drugs for a considerable time. In Pomet's *Histoire des Drogues*, published in 1735, a whole chapter is devoted to the history and uses of Bezoar; and it is only within the last century that it has been expelled from our own Pharmaceutical Codex, as the mode of preparing the powder of Bezoar is to be found in the London Pharmacopœia for 1746.

The diseases for which Bezoars were accounted sovereign remedies include a very numerous class, and of the most opposite character. Monardes, who appears to have been a great admirer of them, says that they are of great efficacy in vertigo, palpitation of the heart, epilepsy, jaundice, worms, and obstruction of the bowels, melancholy, and the whole class of epidemic and contagious fevers. He has given us the history of three cases in which their remedial virtues were exhibited against the effects of poison. It is to be observed,

* *Op. cit.* p. 397.

† *Exoticorum* lib. x. a Carolo Clusio.

however, that in all these cases there is no good evidence of poison having been taken. Even the acute and sagacious Kœmpfer attributes some virtue to the Oriental Bezoar, as he was in the habit of prescribing a few drops of the solution of the stone in nitro-muriatic acid; and he argues that no conclusion can be drawn from the experiment of Ambrose Paré, since he thinks it probable that the proper Bezoar was not administered to the unhappy subject of experiment, as he asserts that all Bezoars do not possess the same efficacy, some being only of power against mineral poisons, and others against those from the animal and vegetable kingdom.

Kœmpfer informs us that it was a very general custom in Persia to take a dose of the powder at the beginning of the year, in the belief that the body would be then protected during the ensuing year from the effects of poison or disease, especially if the medicine had been taken under the influence of a benignant star.

It must be, however, remarked, that in some few instances Bezoars did probably possess a small share of the remedial virtues so liberally bestowed upon them. In several of the concretions in this collection, bile in a more or less altered state has been detected. The tincture of one of these calculi is said in the Sloanian MS. Catalogue to be, "when taken in wine, not only good against all poisons, but that it strengthens a weak stomach and cures gripes in the bowels," properties which we may refer either to the bile it contained, or the wine in which it was infused. There is also reason for believing that the Bezoars were sometimes steeped in infusions of active medicinal plants.

The snake-stone, or *Pedra de Cobra* as it was termed by the Portuguese, on account of its efficacy against the bite of venomous snakes, also affords a good illustration of these bodies actually possessing remedial powers, although the *modus operandi* was very different from that which was asserted. The so-called concretions in the Museum are composed of calcined bone-earth finely powdered, and mixed with musk and some aromatic gums into the form of small, flattened, oval masses. They are highly porous and absorbent; consequently, if a number of these stones were applied in quick succession to a recent bite, they might abstract the poison along with the blood by capillary attraction. Kœmpfer says that it was necessary to have two stones, so that when one fell off the other could be applied; and Tavernier directs that, "if the person be

not much wounded the place must be incised, and the stone being then applied will not fall off till it has drawn all the poison to it." He also informs us, " that there are two ways to try whether the serpent-stone be true or false. The first is by putting it into the mouth, for then it will give a leap and fix to the palate ; the other is by putting it in a glassful of water, for if the stone be true the water will fall a boiling, and rise in little bubbles quite up to the top of the glass ;" facts which clearly prove that the value of the stone depended upon its porosity. The specimens in the Museum are evidently artificial compounds, and both Kœmpfer and Tavernier agree that these stones were manufactured by the Brahmins, and were not taken from behind the hood of the Cobra di Capello, as was commonly believed.

For the fullest and most accurate description of the various species of Bezoars we are indebted to Kœmpfer, who took considerable pains in investigating their history, and who, in order to convince himself of the real origin of the Oriental Bezoar, went a journey of three days into the regions inhabited by the goats. He enumerates the following species : *Masang de Vaca*, *Pedra de Porco* and *Pedra de Porco spuria*, *Bolus pilosus Porcinus*, *Pedra de Cobra*, *Pedra Cordial* sive *Lapis de Goa*, *Coagulum resinosum bezoarticum*, *Lapis Bezoar Orientalis*, *Pedra Bugia*. These concretions were commonly sold as drugs in India and Persia, and Kœmpfer says were frequently offered to him as the genuine medicinal stone. With the exception of the *Masang de Vaca*, which was taken from the gall-bladder of oxen, and was doubtless composed of the brown colouring matter of the bile, and the *Pedra de Cobra* and *Lapis de Goa*, which were artificial compounds, all the others are intestinal concretions ; and as many of the concretions in the Hunterian and Sloanian Collections were thus designated, we shall be enabled, with the accurate description given by Kœmpfer of their external characters, to point out their chemical composition.

The high price set upon Bezoars induced numerous imitations, for the most part composed of chalk and pipe-clay, mixed with musk and various odoriferous gums : in order to give them the high polish of the genuine Oriental Bezoar, they were frequently gilded on the surface. Kœmpfer accuses the eunuchs of the seraglios of manufacturing and vending the false Bezoars. Several of these factitious compounds exist in the Sloanian and Hunterian Collections. A specimen, presented by Mr. Long to the College, had been pur-

chased for fifteen guineas by a gouty gentleman as an antidote to calculous disorders, and was used by him to counteract the injurious effects of punch; for which purpose some of the stone was scraped into the liquor. As the stone consists almost entirely of chalk, it is probable that its efficacy was not altogether imaginary. The *Pedra Cordial* or *Lapis de Goa* appears to have been a species of quack medicine; according to Kœmpfer, it was a compound of various aromatic drugs, mixed with the powder of Bezoar and rolled into globular or oval masses, their external surface being often gilded. This substance was much used as a tonic medicine by the Europeans resident in the East, and was prepared by the Romish priests at Goa, especially by one Nicolaus Monitius, whose manufacture was identified by the figure of a goat being stamped upon one side and the letters N. M. on the other.

Some other varieties of calculi have been described by different authors, as the *Lapis Caymanum* seu *Crocodili*, probably a urinary calculus; the *Lapis Tiburonum* from the seal; but as there are no such specimens in this collection, and their composition has not been determined, any further notice of them would be useless.

The modern history of intestinal concretions may be said to begin with the experiments of Fourcroy and Vauquelin in 1803, who first accurately investigated the composition of these bodies. They divided them into the seven following species: 1. Calculi consisting of superphosphate of lime; 2. of phosphate of magnesia; 3. of phosphate of magnesia and ammonia; 4. of a biliary matter analogous to the colouring matter of the bile; 5. resinous concretions; 6. fungous concretions; and lastly, the hair-balls, or ægagropiles as they were formerly termed*.

The Oriental Bezoars were supposed to belong to the resinous class of concretions, of which Fourcroy recognised two varieties; the first variety were of a light green colour, and had a slightly bitter taste; they readily dissolved in hot alcohol, and the greater part was deposited upon cooling in a crystalline form. These concretions were regarded by Fourcroy as consisting of a substance resembling bile, and of a dry colourless resin. They have been already alluded to as constituting the true *Occidental Bezoar*, and as being identical with the

* *Annales du Muséum National*, iv. 330, 1804.

lithofellinic acid calculi of Prof. Goëbel. As there cannot, however, remain much doubt as to the vegetable origin of these calculi, the name of *resino-bezoardic* acid has been given to them,—a name which does not materially differ from that of *résine animale bezoardique* originally imposed by Fourcroy and Vauquelin.

The second variety of resinous concretions had a brown or violet colour ; they did not possess a bitter taste, were insoluble in alcohol either hot or cold, but readily dissolved in solution of potass or soda. When submitted to destructive distillation, they yielded a concrete yellow sublimate having the taste and smell of soot, and insoluble in water or alcohol. From the examination of the specimens in this collection, it has been determined that these concretions are composed of ellagic acid, and that the term of Oriental Bezoar should be exclusively applied to them.

The composition of the Oriental Bezoar was afterwards investigated by Berthollet, who has given us a most masterly analysis of the three calculi which had been sent to Napoleon by the Shah of Persia. Berthollet considered them to be composed of the woody fibre or lignin of the vegetable substances on which the animals fed*. Dr. Thomson, in his recent work on Animal Chemistry, has regarded them as a separate species under the name of *ligniform* ; there is, however, no doubt that they are identical in composition with the second variety of the resinous concretions of Fourcroy. The nature of the Oriental Bezoar was also examined by John†, and very recently by M. Lippowitz, both of whom have regarded it as consisting of a peculiar matter, to which the last-mentioned chemist has given the name of *bezoaric acid*‡.

Several concretions from the lower animals have been discovered in the Hunterian collection similar in composition to the oaten concretions from Man, being composed of the vegetable hairs of different species of plants, mixed with spiral vessels, portions of cellular tissue, woody, and other foreign matters. In some of these concretions the quantity of earthy phosphates exceeds that of the vegetable matter, and a species of mixed calculus results which has been long known to farriers under the name of *Dung-balls*. These calculi are probably identical with the fungous concretions of Fourcroy, which in most chemical

* *Mémoires de la Société d'Arcueil*, tom. ii. p. 484.

† *Chem. Schr.* iii. 38. Gmelin's *Handbuch der Chemie*, B. ii. S. 828.

‡ Simon's *Beiträge zur Phys. und Pathol. Chemie*, B. i. S. 463.

works are described as consisting of pieces of the *Boletus igniarius* which had been swallowed by the animal and become cemented together by mucus. They commonly contain a resinous matter, which sometimes appears to be of vegetable origin, but more frequently it consists of some of the numerous class of resinous bodies resulting from the decomposition of the bile. One of these concretions, which had been apparently moulded in the cæcum of some animal, contained a very large quantity of a colourless crystalline resin, resembling in most of its properties the *cholic acid* of Gmelin, but so far differing that it could not be precisely referred to that or any other of the known crystalline resins of the bile. The famous *pedra de porco* also belongs to this class of concretions, and it is not improbable but that its virtue depended upon the bile and its products, which the specimens in this collection have been found to contain*. *Lithofellinic acid* has not hitherto been detected in any of these concretions.

With the exception of the above concretions, intestinal calculi are remarkably pure. Those which have a compact laminated or a crystalline structure usually contain but a very small proportion of other salts; phosphate of lime is generally to be found in the triple phosphate calculus, but never to such an amount as to render the calculus easily fusible; carbonate of magnesia is also generally present in concretions consisting of carbonate of lime. Sulphate of lime, peroxide of iron, and the various saline constituents of the gastric and intestinal juices, together with portions of vegetable tissue, form likewise accidental components of these concretions.

Intestinal concretions always contain a large quantity of animal matter, which is uniformly diffused through the calculus and separates in thin layers when the earthy constituents are removed by a diluted acid. The bulk of the animal matter is certainly of an albuminous character, although when digested in boiling water it frequently yields a small quantity of extractive matter, which in some respects resembles gelatine. When examined by the microscope it presents the

* The examination of these calculi has perhaps proved the least satisfactory of any class of concretions. The few points of difference between resinous bodies in general, the numerous substances into which the bile is converted by decomposition, and the imperfect manner in which its resinous products have been investigated, together with the number of ingredients which the calculi contained, and the small quantities on which it was possible to operate, presented obstacles which it was found almost impossible to surmount.

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Several concretions from the lower animals have been discovered in the Hunterian collection similar in composition to the oaten concretions from Man, being composed of the vegetable hairs of different species of plants, mixed with spiral vessels, portions of cellular tissue, woody, and other foreign matters. In some of these concretions the quantity of earthy phosphates exceeds that of the vegetable matter, and a species of mixed calculus results which has been long known to farriers under the name of *Dung-balls*. These calculi are probably identical with the fungous concretions of Fourcroy, which in most chemical

* *Mémoires de la Société d'Arcueil,* tom. ii. p. 484.

† *Chem. Schr.* iii. 38. Gmelin's *Handbuch der Chemie,* B. ii. S. 828.

‡ Simon's *Beiträge zur Phys. und Pathol. Chemie,* B. i. S. 463.

works are described as consisting of pieces of the *Boletus igniarius* which had been swallowed by the animal and become cemented together by mucus. They commonly contain a resinous matter, which sometimes appears to be of vegetable origin, but more frequently it consists of some of the numerous class of resinous bodies resulting from the decomposition of the bile. One of these concretions, which had been apparently moulded in the cæcum of some animal, contained a very large quantity of a colourless crystalline resin, resembling in most of its properties the *cholic acid* of Gmelin, but so far differing that it could not be precisely referred to that or any other of the known crystalline resins of the bile. The famous *pedra de porco* also belongs to this class of concretions, and it is not improbable but that its virtue depended upon the bile and its products, which the specimens in this collection have been found to contain*. *Lithofellinic acid* has not hitherto been detected in any of these concretions.

With the exception of the above concretions, intestinal calculi are remarkably pure. Those which have a compact laminated or a crystalline structure usually contain but a very small proportion of other salts; phosphate of lime is generally to be found in the triple phosphate calculus, but never to such an amount as to render the calculus easily fusible. Sulphate of lime, peroxide of iron, and the various saline constituents of the gastric and intestinal juices, together with portions of vegetable tissue, form likewise accidental components of these concretions.

Among the calculi brought from the British Museum was a large pear-shaped concretion, weighing more than ten pounds, which was stated to have been taken from the stomach of a gelding above seventeen years old. On submitting this calculus to analysis, it was found to resemble in composition the urinary concretions from the Horse, being composed of carbonate of lime mixed with carbonate of magnesia and a small quantity of oxalate and phosphate of lime. As it did not have any foreign body for its nucleus, and no remains of vegetable matter could be detected between its layers, it is most probable that it was taken

* The examination of these calculi has perhaps proved the least satisfactory of any class of concretions. The few points of difference between resinous bodies in general, the numerous substances into which the bile is converted by decomposition, and the imperfect manner in which its resinous products have been investigated, together with the number of ingredients which the calculi contained, and the small quantities on which it was possible to operate, presented obstacles which rendered their exact analysis almost impossible.

from the urinary bladder, among which concretions it has, therefore, been placed. Carbonate of lime is, however, frequently present in intestinal concretions of oxalate of lime, as 11 per cent of that salt was found in a specimen in this collection, and M. Guibourt has given the analysis of a concretion, the earthy salts of which consisted of carbonate of lime 43·55, oxalate of lime 34·30, sulphate of lime 2·85, carbonate of magnesia 2·34*.

Intestinal concretions always contain a large quantity of animal matter, which is uniformly diffused through the calculus and separates in thin layers when the earthy constituents are removed by a diluted acid. The bulk of the animal matter is certainly of an albuminous character, although when digested in boiling water it frequently yields a small quantity of extractive matter, which in some respects resembles gelatine. When examined by the microscope it presents the appearance of a thin, transparent, structureless or slightly granular membrane, in which only a few epithelial particles are occasionally seen.

The minute branched tubes already described as occurring in urinary calculi are very abundant in these concretions, and many of them distinctly belong to the class of Confervæ: others more closely resemble the irregular tubes found in the animal matter of coral and shell†. It therefore appears from its structure and chemical characters that the animal matter of intestinal concretions does not consist merely of mucus, as hitherto supposed, but that it forms a distinct tissue similar to that of urinary concretions.

Intestinal concretions occur more frequently in herbivorous than in omnivorous animals. In carnivorous animals they have never been observed. Leopold Gmelin states that the phosphate of magnesia calculus is found only in the intestines of carnivorous animals ‡; but there is most probably some error in this statement, as all the concretions in this Museum belonging to that variety have some vegetable substance, as a seed, &c., for their nucleus. The reason of the occurrence of calculi in animals feeding upon vegetable matters is sufficiently obvious, if we take into consideration the nature of their food, the complicated structure of their digestive apparatus, and the composition of the concre-

* *Journal de Pharmacie et de Chimie,* tom. 3. p. 124.

† Vide a paper by J. S. Bowerbank, Esq., F.R.S., in the Transactions of the Royal Society for 1842.

‡ *Handbuch der Chemie,* B. 2. S. 1448.

tions themselves. The whole series of intestinal calculi are composed of the various earthy salts, or other insoluble constituents of vegetable substances. The quantity of inorganic constituents is smaller in animal than in vegetable food, and the whole is required to enter into the composition of the new tissues, consequently these concretions are never found in carnivorous animals. The complicated stomachs of the Ruminants, and the large size and length of the alimentary canal in herbivorous animals generally, must not only favour the formation of a calculus, but also render its expulsion, when formed, less easy. Another disadvantage also arises from the circumstance, that during the evacuation of their excrement these animals usually stand upon all-fours; the gut is therefore placed in a horizontal position, and is consequently unaided in its efforts by the power of gravity.

Intestinal calculi are found of every size from that of a small nut to several inches or even a foot in diameter. Of the earthy concretions, those consisting of phosphate of magnesia and ammonia attain the largest size. There is one of these calculi in the Museum which measures ten inches in diameter and weighs nearly eighteen pounds. A hair-ball taken from the stomach of a cow is also in this collection which has attained the enormous size of forty inches in circumference.

Oxalate of lime concretions, and those composed of vegetable hairs are also frequently of large size. Ellagic acid and resino-bezoardic (*lithofellinic acid*) concretions are usually the smallest; there is, however, one of the latter in the Museum nearly four inches in diameter, and which has evidently been accompanied by other concretions. The figure of intestinal calculi usually depends upon the form of the nucleus; as they increase in size they always approximate to an oval or spherical shape. Their external surface is either smooth, tuberculated, crystalline, or irregularly nodulated. Phosphate of lime, ellagic acid and resino-bezoardic calculi are invariably smooth and polished, while triple phosphate calculi are either smooth or crystalline. The only concretion which possesses a perfectly characteristic exterior is that composed of phosphate of magnesia, which is covered with irregularly-shaped, flattened plates or tubercles, somewhat resembling the folds of the skin of the rhinoceros, from which circumstance they were formerly termed Rhinoceros Bezoars.

In the Horse the stomach appears to be the most frequent seat of concretions,

from whence they descend into the intestinal canal, in the narrower parts of which they sometimes become impacted, where they produce violent inflammation, and occasionally rupture, of the intestine*.

With regard to the manner in which these concretions are formed, it is exceedingly difficult to give a satisfactory explanation. That they are composed of some one or other of the insoluble parts of the food of the animal is easily demonstrated; but it is not so easy to explain why these substances should occasionally become united into a compact laminated or crystalline mass. The presence of a foreign body in the stomach, as a piece of wood or a stone, is certainly one of the conditions necessary for the formation of a calculus, and by some authors this fact has been supposed to favour the notion of the calculous matter being secreted by the mucous membrane as a means of protecting itself from injury. The difference in the composition of these concretions, however, clearly shows the incorrectness of that view of their formation; according to which they should uniformly consist of phosphate and carbonate of lime.

M. Guibourt, who agrees with Kœmpfer as to the vegetable origin of the Oriental Bezoars, has thrown out the idea that the resinous and other constituents of the plants have been absorbed into the system of the animal and afterwards deposited in the various organs of the body, and he adduces some very remarkable facts, with regard to the composition and peculiarities of the odour of various kinds of castoreum, in support of this hypothesis †. The circumstance of the Oriental Bezoars being usually found in some part of the stomach of the wild goat, militates however very strongly against the notion of their being the products of secretion.

The opinion which at the present time will probably meet with the most ready assent is, that the earthy bases, or the insoluble vegetable constituents of the calculus, are separated from the food during the act of digestion, and that, assisted by a morbid condition of the gastric or intestinal juices, they have become simply aggregated together as in the ellagic acid and resinous concretions, or deposited in the crystalline form from a previous state of solution, as in the

* Morton on Calculous Concretions in the Horse, &c.

† *Journal de Pharmacie et de Chimie*, Fevrier 1843.

triple phosphate and phosphate of lime concretions ; the foreign body forming the nucleus merely favouring the process of crystallization by affording a point on which the solid matter is first deposited.

The intestinal concretions from the lower animals have been divided into the following classes. The figures indicate the number of specimens belonging to each variety at present in the Museum. Ambergris has been placed among them, as it is now well ascertained that it is formed in the intestines of the Cachalot or Spermaceti Whale, *Physeter macrocephalus*. The remarkable analogy in the chemical relations of its fatty matter to cholesterine would however lead us to regard it as a product of the biliary organs ; in fact, that it is the cholesterine of the Whale.

O.	Calculi consisting principally of animal hairs.—*Ægagropiles*.	56
P.	vegetable hairs.	32
Q.	ellagic acid.—*Oriental Bezoar*.	19
R.	resino-bezoardic acid. *Occidental Bezoar*.	23
S.	phosphate of magnesia and ammonia	65
T.	diphosphate of magnesia.	15
U.	diphosphate of lime.	58
W.	oxalate of lime.	5
Y.	ambergris.	4

CONCRETIONS CONSISTING OF ANIMAL HAIRS.

The hairs which are swallowed by animals while licking themselves frequently become felted together in the alimentary canal, and form the solid masses commonly known by the name of Hair-balls. These concretions are of common occurrence in Goats, whence the term of Ægagropiles became applied to them *. They were also termed Bezoar Germanicum, from their being brought from Germany, where they were pretended to be formed from the *Doronicum* or *Wolf'sbane* on which the goats fed. Hair-balls are usually of a globular or

* Αἴγαγρος, a wild goat, and πῖλος, felt.

regular oval figure; they frequently attain a very large size; one of the specimens in this collection, taken from the stomach of a Cow, measures ten inches across. In some of these concretions the hair appears on the exterior, and owing to the rotatory motion which the calculus undergoes in the stomach and intestinal tube, the hairs become disposed in a very regular manner around its long axis, as is shown in Plate XVI. fig. 5; others are coated by a thin crust, composed of the phosphates or carbonates of lime and magnesia. It is said that these are found only in the intestines.

Mr. Morton informs us that hair-balls are commonly found in the first division of the stomach of calves*, and according to Mr. Youatt, they occur in the rumen and abomasum of cattle. In the abomasum they are composed exclusively of hair irregularly matted together, while those of the rumen generally contain a mixture of food or earthy matter, with a fragment of stone or a nail in the centre.

Several of the concretions in the Museum are exceedingly impure, being mixed with vegetable hairs, bran, and the earthy constituents of the food of the animal. Very few have any foreign body as their nucleus.

⊕. *Animal Hairs.—Ægagropiles.*

⊕ 1. An oblong hair-ball, the hairs of which are arranged in a regular spiral manner around its long axis. Vide Plate XVI. *Hunterian.*

⊕ 2. A similar specimen, having a spherical figure, the hair coarse and of a grey colour; apparently from the Goat. *Hunterian.*

⊕ 3. A circular hair-ball, apparently from a Cow. *Hunterian.*

⊕ 4. A large flattened circular concretion, also from a Cow. *Hunterian.*

⊕ 5. Hair-ball from a Cow, of a globular figure. *Hunterian.*

⊕ 6. A nearly circular hair-ball, the hairs of which are not arranged in a uniform manner around one of its axes, but pursue opposite directions. This circumstance arises from an alteration in the rotatory motion of the concretion while in the intestine. *Hunterian.*

* On Calculous Concretions in the Horse, &c.

Ⓟ 7. A similar specimen. *Hunterian.*

Ⓟ 8. A large round concretion from the Cow, the hairs of which preserve an uniform direction. *Hunterian.*

Ⓟ 9. An egg-shaped hair-ball, the surface of which has been attacked by moths. *Hunterian.*

Ⓟ 10. A globular hair-ball, divided in the direction of its external hairs. *Hunterian.*

Ⓟ 11. A large, flattened, oval hair-ball, divided longitudinally. *Hunterian.*

Ⓟ 12. An oval mass, composed of hogs' bristles, mixed with a large quantity of vegetable fibre and earthy matter. *Hunterian.*

Ⓟ 13. Twenty-one flattened, oval concretions, taken "from a Calf." They are composed of hair and undigested vegetable matter. *Hunterian.*

Ⓟ 14. A section of a globular hair-ball, coated by a thin crust composed of phosphate of lime with phosphate of magnesia and ammonia, carbonate of lime and intestinal mucus. "From the stomach of a Goat, Mosco." *Hunterian.*

Ⓟ 15. A spherical hair-ball, the surface of which is coated by a thin crust of a light grey colour, consisting principally of carbonate and phosphate of lime. *Hunterian.*

Ⓟ 16. An egg-shaped concretion of hair, coated with a crust composed principally of phosphate of magnesia and ammonia; probably from the Cow. Vide Plate XVI. *Leverian Museum*, 1806.

Ⓟ 17. A flattened circular hair-ball, also coated by an earthy crust of a dark brown colour. *Hunterian.*

Ⓟ 18. A similar specimen, undivided. *Hunterian.*

Ⓟ 19. A similar specimen, of a light brown colour. *Hunterian.*

Ⓟ 20. A flattened circular hair-ball, having an earthy crust on its exterior. *Hunterian.*

Ⓟ 21. A globular hair-ball, described in the Sloanian MS. Catalogue as

"Boopila corticata in ventriculo veteris vaccæ in pago Gais, cantonis Abatiscellani reperta. From Dr. Lavater, from Switserland."

British Museum.

Ⓔ 22. A spherical concretion, consisting of closely-felted, dark-coloured hair, having a dark brown tuberculated crust, consisting principally of phosphate, sulphate and carbonate of lime; "said to have been found on the Mediterranean, near the shore." *Hunterian.*

Ⓔ 23. A large, flattened, circular hair-ball, coated by a thin earthy crust, taken from a Cow. Presented to Mr. Hunter by Sir Hector Munro.

Hunterian.

Ⓔ 24. A similar specimen of a regular oval figure. *Hunterian.*

Ⓔ 25.
Ⓔ 26.
Ⓔ 27.
Ⓔ 28.
} Hair-balls, coated by a thin crust of earthy matter. These concretions are nearly alike in colour, size and general appearance. *Hunterian.*

Ⓔ 29. A similar concretion, divided, brought from the Cape of Good Hope.

Hunterian.

Ⓔ 30. A similar concretion, undivided, taken from the stomach of a Highland Goat. *Hunterian.*

Ⓔ 31. A divided hair-ball, having a thick earthy crust. *Hunterian.*

Ⓔ 32.
Ⓔ 33.
Ⓔ 34.
} Small globular hair-balls, covered externally by earthy matter. *Hunterian.*

Ⓔ 35. A flattened oval concretion, having a thin earthy crust. *Hunterian.*

Ⓔ 36. A section of a similar concretion. *Hunterian.*

Ⓔ 37. A small globular concretion, the earthy crust of which is irregular, and of a light grey colour. *Hunterian.*

Ⓔ 38.
Ⓔ 39.
Ⓔ 40.
Ⓔ 41.
} Globular concretions, consisting of short hair, with vegetable and earthy matter. These concretions do not possess an earthy crust, but the materials of which they are composed are so blended together, that the hair does not appear at the surface.

Ⓟ 42. A small oblong ball, composed of hair and vegetable matter rolled and felted together. "From the stomach of a Porcupine." *Hunterian.*

Ⓟ 43. A small round ball, composed of various coloured hairs, many of them from two to four inches in length. "From the stomach of a young Cuckoo." *Hunterian.*

Ⓟ 44. An oblong concretion, composed of Cow's hair. *Hunterian.*

Ⓟ 45. "An Ox hair-ball from the Orkneyes, from Dr. Reston." The hair is long, of a dark brown colour, and is arranged in various directions on its surface.—*Sloanian MS. Catalogue.* *British Museum.*

Ⓟ 46. A small hair-ball, made up of long black and white hairs. Taken from the stomach of a Chilian Ox. *Presented by W. Cuming, Esq*, 1842.

Ⓟ 47. A hair-ball of a light brown colour, having a rude triangular figure. From a Cow. *Leverian Museum.*

Ⓟ 48. An oblong mass of grey-coloured hair, felted together in the alimentary canal of some animal, probably the Goat. *Leverian Museum.*

Ⓟ 49. A large globular ball from a Cow, the hairs being disposed in a very regular manner around its long axis. From the stomach of a Cow.
Presented by William Clift, Esq., 1820.

Ⓟ 50. A large, flattened, circular hair-ball, uniformly coated by a smooth crust, consisting of phosphate and carbonate of lime: "A very large Tophus Bovinus, taken out of the first ventricle of a large fat Ox slaughtered at Chelsea. Given to me by the butcher that took it."—*Sloanian MS. Catalogue.* *British Museum.*

Ⓟ 51. A perfectly globular hair-ball, covered by a smooth earthy crust.
Presented by Wm. Clift, Esq., 1807.

Ⓟ 52. A similar specimen, of a flattened oval form; the earthy crust consists of phosphate and carbonate of lime, with phosphate of magnesia and ammonia. From a Cow. *Presented by J. Moore, Esq.*, 1815.

Ⓟ 53. A small globular hair-ball, coated with a smooth earthy crust, said to have been taken from some part of the alimentary canal of a Cow.
Presented by Wm. Clift, Esq., 1822.

Ⓕ 54. A large hair-ball, surrounded by an earthy crust. Taken out of the stomach of an Ox slaughtered at Buenos Ayres.

Presented by W. A. Hillman, Esq., 1843.

Ⓕ 55. Four small globular concretions, being part of twenty that were taken from the stomach of a Lamb: they are made up of wool closely felted together. *Presented by Everard Home, Esq.*, 1807.

Ⓕ 56. A very large hair-ball, taken from the intestines of an Ox that was slaughtered at Buenos Ayres. It is nearly spherical, is coated by a thin earthy crust, and measures forty inches in circumference. *British Museum.*

CONCRETIONS CONSISTING OF VEGETABLE HAIRS.

The small hairs which cover the surface of most plants occasionally become felted together in the alimentary canal of herbivorous animals, and form concretions similar in most respects to those already described as occurring in the human subject. These concretions do not possess any regular appearance or structure; some are nothing more than a mass of vegetable fibre, earthy matter, &c., confusedly aggregated together, while others possess a laminated structure, and have a soft velvety feel. In addition to the vegetable hairs, of which the bulk of the concretion usually consists, portions of cellular tissue, woody fibre, and spiral vessels are to be found mixed with gum, resin, and an extractive matter resembling ulmic acid, together with various saline and earthy salts, sand, and the hairs of the animal. They also contain variable quantities of more or less altered bile, which appears to have been absorbed by the concretion and become decomposed. A concretion in this Collection, taken apparently from the cæcum, was found to contain above fifty per cent. of a crystalline nitrogenous resin, resembling in most of its properties the cholic acid of Gmelin, mixed with various other products resulting from the more or less complete decomposition of the bile, and which constitute the biliary resin of Gmelin* The concretions termed *Pedra de Porco* in the Sloanian MS. Catalogue were found to have a

* The substance termed biliary resin by Gmelin consists of cholinic, fellinic and choloidic acids, with dyslysine, &c., the relative proportion and even the nature of which differ according to the more or less complete decomposition of the bile.

similar composition. Kœmpfer describes two varieties of this concretion, a true and a false. The first, he says, was taken from the gall-bladder of the Porcupine, that it was extremely valued by the Malays for its medicinal virtues, who set it in hoops of gold and silver: the false stone, on the other hand, was taken from the stomach of the Porcupine, and although it resembled the former in some respects, it was of a less regular shape and was mixed with hairs. He refers the bitter taste of these concretions to the bile they absorbed, and says that the presence of a stone in the stomach was indicated by the frequent attempts of the animal to vomit*. The figures given by Kœmpfer of these concretions correspond with some of the specimens in the Museum; but the only difference between the true and false stone appears to be, that one contains a larger quantity of vegetable fibre, and there is every reason for believing that both kinds were taken from the stomach or some other part of the alimentary canal of the Porcupine.

In the Horse these concretions usually occur in the cæcum and colon. They frequently contain large quantities of phosphate of magnesia and ammonia, with undigested food, &c., and are termed by farriers *Dung-balls*. Horses not uncommonly suffer from the presence of these concretions, and they sometimes produce rupture of the intestine.

℘. *Vegetable Hairs.*

℘ 1. A section of a large round concretion, composed of the setæ on the oat-seed, mixed with earthy matter. It measures five inches and a half in diameter, and was probably taken from a Horse. *British Museum.*

℘ 2. A section of a similar concretion from the Horse. It is of an oval figure, its exterior is tuberculated, and it has a horseshoe nail for its nucleus.
Presented by Sir Wm. Blizard, 1810.

℘ 3. A large spherical concretion, similar in composition and structure to the preceding specimen. Its exterior is tuberculated and of a very dark colour. *Hunterian.*

℘ 4. A similar concretion. *Hunterian.*

* *Op. cit.*

℔ 5. A globular mass of vegetable hairs and fibre, mixed with earthy matter. The exterior is tuberculated and of a dark colour. *British Museum.*

℔ 6. A globular concretion, which measures four inches and a half in diameter, and was taken from the rectum of a Horse. The animal had been ridden a considerable distance at a quick pace on the day of its death: on its return to the stable it laid down and rolled about apparently in great agony, and shortly after died. The calculus consists of an heterogeneous mixture of the setæ of the oat-seed and earthy matter. Its surface, which is extremely rugged, is coated by a crust of phosphate of magnesia and ammonia. *Presented by Sir Humphry Davy*, 1831.

℔ 7. Twenty-one laminated concretions, consisting almost wholly of vegetable hairs. In the Sloanian MS. Catalogue they are stated to have been given to Sir Hans Sloane by a butcher, who took them out of a Sheep's stomach. *British Museum.*

℔ 8. Seven concretions, similar in composition and appearance to the preceding. *Hunterian.*

℔ 9. Four small concretions, composed of vegetable hairs: from a Kid. *British Museum.*

℔ 10. An intestinal concretion, having a regular tetrahedric figure. It is composed of fine vegetable hairs, and its interior is of a brick-red colour. *Presented by Everard Home, Esq.*, 1807.

℔ 11. A globular concretion, similar in composition to the preceding; described in the Sloanian MS. Catalogue as "Ægagropila ex Dama Americana." *British Museum.*

℔ 12. A small flattened concretion, composed of vegetable hairs deposited upon a cherry-stone; described in the Sloanian MS. Catalogue as "a false Occidental Bezoar." It resembles the oat-hair concretions from the human subject. *British Museum.*

℔ 13. A small concretion, composed of vegetable hairs. *Hunterian.*

℔ 14. A large concretion, of a curved pyriform figure, apparently from having been moulded in the cæcum of some animal. It consists of 32 per cent.

of long vegetable hairs, mixed with hay, sand, &c.; the rest of the calculus is composed of substances derived from the decomposition of the bile which the calculus has absorbed while in the intestine. The principal ingredient is a colourless resinous matter, which crystallizes in small transparent prisms, usually arranged in stellate tufts. It readily fuses into an amorphous vitreous mass; when heated more highly it swells up, catches fire, and emits the odour of burning animal matter. It is sparingly soluble in water, dissolves readily in alcohol, and the solution is precipitated by water; the precipitate after some time becomes crystalline. It dissolves with great facility in solutions of potass, soda and ammonia, the solutions when evaporated form transparent vitreous masses without any crystalline structure. From its alkaline solutions this substance is thrown down by muriatic, sulphuric and acetic acids as a gelatinous precipitate, which after a short time becomes aggregated into small crystalline tufts. Its ammoniacal solution is not decomposed by boiling, and gives a white flocculent precipitate with dilute solutions of the nitrates of baryta, lead, silver, and muriate of lime. When heated with a mixture of lime and soda, ammonia is evolved. This substance, therefore, resembles very closely the cholic acid of Gmelin, the chief difference being that its soda salt is not crystalline. Mixed with the above substance was a considerable quantity of the biliary resin of Gmelin, with bile, gum, and a vegetable extractive matter. *Hunterian.*

℔ 15. The outer layers of an intestinal concretion, described in the Sloanian MS. Catalogue as "a Porcupine stone; the tincture drunk with wine is good for all sorts of poisons. It is of great value in Holland; it strengthens a weak stomach and cures gripes in the bowels. From Dr. Cyprianus. 'Tis cutt or used, and lyes SSS." (*stratum super stratum*). This concretion consists of 35 per cent. of long divaricating hairs, mixed with spiral vessels, portions of woody fibre, cellular tissue, and sand. It also contains bile, biliary resin, mucus, together with a vegetable extractive matter resembling ulmic acid and gum. This concretion resembles those described by Kœmpfer under the name of *Pedra de Porco spuria*, which he says were found in the stomach of the Porcupine.

It is however probable that the above was taken from a larger animal, perhaps from the Deer or Goat. Vide Plate XVII. figs. 9, 10.

British Museum.

℔ 16. An intestinal concretion, of a rude tetrahedric figure with flattened sides from having been in contact with other concretions. It consists of long spindle-shaped vegetable hairs, mixed with spiral vessels, &c.; it possesses a bitter taste, and resembles in its general composition the preceding specimen. *Hunterian.*

℔ 17. A cylindrical mass of coarse vegetable hairs. It is flattened at each end, and has apparently been in contact with other concretions.

British Museum.

℔ 18. An oval calculus, of a brown colour, having an earthy texture. This concretion is described in the Sloanian MS. Catalogue as "ex cysti fellea bovina." It is however an intestinal concretion, and consists of a large quantity of biliary resin mixed with various-shaped vegetable hairs, fragments of cellular tissue and other parts of plants; it also contains vegetable extractive matter, gum, and a small quantity of bile. *Hunterian.*

℔ 19. Two globular concretions, surrounded by silver hoops and attached to each other by a chain of the same metal. They possess a compact laminated structure, and are composed of short vegetable hairs, mixed with woody fibre and spiral vessels, the whole being cemented together by a bitter extractive matter, gum, resin, mucus and bile. In the Sloanian MS. Catalogue they are said to be "two stones of *Porco*, procured at the Jesuits' college at Lisbon by Dr. Sarmento of Zeylon." These concretions are very similar in appearance to those figured by Kœmpfer in the *Amœnitates Exoticæ* as the *Pedra de Porco pretiosa Malaccensis*, which he says were procured from the gall-bladder of the Porcupine. When a portion of one of these concretions is heated it emits a disgusting odour, resembling that of the Porcupine. Vide Plate XVII. fig. 11.

British Museum.

℔ 20. A section of a small concretion, apparently similar in composition to the preceding. It has a piece of twig for its nucleus. *British Museum.*

℔ 21. An oval calculus, similar in composition to the preceding specimen. Its exterior is coated by a dark brown resinous-looking matter, which has a very bitter taste. "*Piedra del Porco spinosa*, from the island of Bona. From Mr. Van Huffe."—*Sloanian MS. Catalogue.* *British Museum.*

℔ 22. A section of a small dark brown concretion, consisting principally of vegetable hairs. *Hunterian.*

℔ 23. An oblong mass, consisting of hay and other vegetable matter mixed with hog's bristles. "Massa oblonga setacea in ventriculo Suillo reperta. From Dr. Lavater. From Switzerland."—*Sloanian MS. Catalogue.* *British Museum.*

℔ 24. Three oblong masses and a section of a fourth, all of them consisting of undigested vegetable fibre. Described by Mr. Hunter as "Balls of the Chamois." *Hunterian.*

℔ 25. A coiled mass of vegetable hairs, coated by a thin crust of the earthy phosphates. "Found in the stomach of an Ox."—*Sloanian MS. Catalogue.* *British Museum.*

℔ 26. A small oval concretion, composed of undigested vegetable fibre, coated by a thin dark-coloured earthy crust. Taken from the stomach of a Buffalo. *Presented by Dr. Richardson*, 1822.

℔ 27. An oblong flattened mass, similar in composition to the preceding. *Hunterian.*

℔ 28. A loosely compacted mass of vegetable fibre, from the intestine of some animal. *Hunterian.*

℔ 29. A small spherical ball, precisely similar in composition to the preceding. *Hunterian.*

℔ 30. An oblong mass of undigested vegetable fibre, described in the Sloanian MS. Catalogue as "an Ægagropila or ball taken out of the stomach of the Rupicapra or Chamois, with a black crust upon it. Given me by Dr. Lavater, from Swisserland. Ægagropila completa, oblonga, cortice obducta." *British Museum.*

℘ 31. A round ball, composed of coarse vegetable fibre, mixed with earthy matter. *Hunterian.*

℘ 32. An oblong mass of hair and undigested vegetable matter, from the stomach of a Kangaroo. *Presented by R. Owen, Esq.*, 1835.

CALCULI CONSISTING OF ELLAGIC ACID.—THE ORIENTAL BEZOAR.

When an infusion of gall-nuts is exposed to the air for some weeks, and the vegetable mould which forms on its surface is removed from time to time, a crystalline powder is gradually deposited, which consists for the most part of impure gallic acid; if this deposit be digested in boiling water its gallic acid is dissolved, and there remains behind a dirty buff-coloured powder. This insoluble residue contains gallate of lime, ulmic acid and some other matters, but consists chiefly of the substance to which Braconnot has given the fanciful name of Ellagic acid, derived from the word *galle* reversed*. During the examination of the calculi in this Collection, several concretions have been found consisting almost entirely of the ellagic acid of Braconnot.

Ellagic acid calculi are generally of an ovoid figure; their outer surface is smooth, polished, and of a deep olive or greenish brown colour; internally they are brown; they are made up of thin concentric layers, which in some cases adhere so slightly together, as to cause the calculus to fall to pieces on attempting to divide it with a saw. When the outer layers of these calculi are removed, the exposed surface readily acquires a high polish by slight friction, and when cut or scraped they assume a waxy lustre. These calculi invariably contain some foreign body as their nucleus, which is generally a small twig or seed.

The chemical characters of the constituent of these calculi agree so exactly with those of ellagic acid procured from the infusion of gall-nuts, as to leave no doubt of their being composed principally of that substance. When heated they do not fuse, but emit a slight balsamic odour and partially sublime; if more highly heated they catch fire, burn with a low flame, give off the smell of burn-

* *Ann. de Chim. et de Phys.* ix. 187.

ing wood, and leave behind a carbonaceous ash. If the powder of the calculus be heated in a glass tube a yellow sublimate is produced, which condenses in the form of long spear-shaped crystals of a yellow colour, with a shade of green. These crystals do not differ in their chemical habitudes from the powder of the calculus, and they are identical in shape and appearance with those procured from the ellagic acid of the gall-nut when similarly treated. When the calculus is reduced to powder and diffused through water, several days elapse before the whole of the powder is deposited, and the water remains opalescent even for weeks. It is also difficult to separate the powder by filtration, as the liquid passes turbid for some time.

Ellagic acid calculi easily dissolve, with the exception of a few flocks, in a cold solution of caustic potass or soda. The solution is of a deep brownish red colour, with a shade of green ; when the ellagic acid is, however, freed from some extractive or colouring matter with which it is generally mixed in the calculus, the solution is of so deep a yellow as to appear red when viewed in bulk. Muriatic acid throws down from the potass solution a greenish, buff-coloured powder, while the supernatant liquor is of a light red colour. If the precipitate be examined by the microscope, it is seen to consist of small thread-like particles, generally blunt, but sometimes tapering at their extremities, and which are occasionally twisted or curved, especially if the solution from which they were thrown down was hot: they are not transparent, and can scarcely be termed crystals.

When the potass solution is exposed to the air, oxygen and carbonic acid are absorbed, the solution becomes much darker-coloured, and a silky greenish yellow precipitate is deposited, consisting of ellagate of potass. This precipitate appears under the microscope as thin rectangular plates, frequently arranged in stellate groups. If a current of carbonic acid is passed through the solution, a buff-coloured precipitate of ellagate of potass is thrown down, while the supernatant liquid remains of a dark reddish colour.

Ellagic acid calculi are very sparingly soluble in solution of ammonia; the liquid acquires a yellow colour, which on exposure to the air becomes brown and turbid. The small quantity of ellagic acid dissolved is precipitated by an acid.

Concentrated sulphuric acid readily dissolves these calculi when assisted by a gentle heat. The solution is of a greenish brown colour, and is precipitated by

dilution with water. The precipitate has the form of minute prisms arranged in stellate groups; the extremities of some of the prisms are blunt, others are pointed.

When mixed with nitric acid, the ellagic acid calculus dissolves. If the acid be strong or slightly warmed, effervescence takes place, nitrous fumes are given off, and a solution is produced of a beautiful pink-red colour, similar to that produced by the action of nitric acid upon uric acid. The red colour quickly disappears upon standing; on being heated, a deep yellow solution remains, from which crystals of oxalic acid may be obtained by evaporation. Ammonia added to the solution causes it to assume a red colour, but does not render it turbid.

The ellagic acid is best obtained from these calculi by dissolving the powdered calculus in a weak solution of caustic potass, and transmitting through it a current of carbonic acid. The precipitate which falls is to be digested in diluted muriatic acid, by which the potass is removed, and tolerably pure ellagic acid remains. During the whole of the operation great care must be taken to prevent the contact of atmospheric air, for when dissolved in alkaline liquids, ellagic is quickly converted into a species of ulmic acid. It is not improbable that catechuic acid is sometimes present in these calculi.

This species of intestinal concretion appears to have been first examined by Fourcroy and Vauquelin, and is included in their class of *resinous* Bezoars*. It was shortly afterwards examined by Berthollet, and subsequently by other chemists, all of whom failed in deciding upon its true nature; even so recently as 1843 this calculus was described by M. Lippowitz as consisting of a peculiar organic acid, for which he proposed the name of Bezoaric acid†.

The concretions analysed by Berthollet, and of the properties of which he has given a very accurate account, had been presented to the Emperor Napoleon by the Shah of Persia. They were of a greenish brown colour externally, and brown within; they had an oval figure, and their surface was highly polished; they

* "La seconde variété d'une couleur brune ou violacée, sans saveur amère, presque insoluble dans l'alcohol, entièrement soluble dans les alcalis, donnant dans cette dernière dissolution une liqueur qui devient rouge purpurine, lorsqu'elle s'épaissit et se sèche à l'air: fournissant à la distillation un sublimé concret, jaune, d'une saveur et d'une couleur de suie insoluble dans l'eau et dans l'alcohol."—*Annales du Muséum National*, tom. iv. 334.

† Simon's *Beiträge zur Phys. und Pathol. Chemie und Mikroskopie*, B. i. 463.

were formed of irregular concentric layers, and in the centre of all of them was some vegetable matter; their sp. gr. = 1·463*. They were regarded by Berthollet as consisting of the woody fibre (*lignin*) of the food of the animal, and he conjectures that they must have been taken from the stomach, on account of the little alteration which the vegetable matters that formed their nucleus had undergone.

The constituent of the ellagic acid calculus is likewise described by John under the name of *Bezoarstoff* †; and Leopold Gmelin thinks it probable that the calculi examined by John were identical in composition with those analysed by Berthollet ‡, and that they consisted of a species of ulmin arising from the decomposition of woody fibre or lignin.

From the descriptions which Tavernier, Kœmpfer, and other Oriental travellers have given of the Oriental Bezoar, corroborated by the analyses of Fourcroy and Berthollet, there is no doubt that it is identical with the ellagic acid concretion above described. The signs by which a true Oriental Bezoar might be distinguished were, according to Tavernier, by steeping it in hot water, and observing whether the liquid became coloured, or the stone lost in weight. If either of these occurred, the stone was to be regarded as fictitious: but the best test was to apply a red-hot iron wire to the calculus, when, if it melted and permitted the iron to enter, it was certainly fictitious. Another test consisted in smearing a piece of paper with chalk, and rubbing the calculus over it. The genuine stone always left a greenish mark. All these criteria would be fulfilled by the ellagic acid calculus, but by none of the other species.

This species of concretion was the most valued of the Bezoars, and is denominated by Kœmpfer the "verus et pretiosus *Pasahr*," from which word, by a corruption of sound, he believes the word Bezoar to have been derived.

With regard to the origin of this concretion, we have the fullest and most satisfactory evidence. W. Methold, Fryer, Tavernier and Kœmpfer all agree that it is taken most frequently from the alimentary canal of a species of wild goat termed *Pasen* by the Persians, which inhabits the mountainous ridges in Persia, particularly in the province of Chorasaan or Chorasmia. Tavernier states that they also come from some parts of the kingdom of Golconda. The account as to the exact situation of the stone is however not so clear.

* *Mémoires de la Société d'Arcueil*, tom. ii. p. 448.

† *Chem. Schr.* iii. 38.

‡ *Handbuch der Chemie*, B. ii. S. 828, 1488.

Most writers indicate the maw or stomach: Kœmpfer says it is found in the pylorus, "sive productior quarti, quem vocant ventriculi fundus*," and that the natives are in the habit of ascertaining how many stones are contained in the stomach by feeling through the parietes of the abdomen, the value of the animal being considerably enhanced by their presence. When recently taken from the animal, they are said to be somewhat soft, or of the consistence of a hard-boiled egg, and that in order to preserve them it was customary to place them in the mouth, and retain them there until they acquired greater hardness.

The Oriental Bezoar was not however confined to the wild goats, or to the ruminant tribes, as the *Pedra Bugia* or Ape stone also consists of ellagic acid. These concretions were held in higher esteem than those from the Goat, and were generally included, for the sake of preserving them, in a small cavity scooped out of two portions of a very light wood, which were held together by hoops wove from the twigs of the Rotang cane. There is in the Museum a specimen preserved in this manner. Kœmpfer informs us that they were found in a species of Ape termed Antar by the Mongols, which he believes to be the *Babianum cynocephalum*. The composition of these concretions renders their origin no longer a matter of uncertainty, and confirms, in a very remarkable manner, the statements of Tavernier and Kœmpfer, that they are derived from the juices of the plants on which the animals fed.

Q. *Ellagic Acid.*

Q 1. A large and very fine specimen of the true Oriental Bezoar. This calculus measures two inches and three quarters in length, and rather more than two inches and a half in breadth. Its exterior is of a deep rich brown colour, and is highly polished. It is made up of thin concentric layers surrounding a piece of wood; immediately around the nucleus is a softer unlaminated portion, which consists of the matter of the calculus mixed with a few vegetable hairs. From its large size and regular figure, this calculus must have been of very considerable value in Persia, from

* *Op. cit.* p. 400.

which country it was most probably brought. It consists of ellagic acid mixed with some extractive and colouring matter. *Hunterian.*

Q 2. An ellagic acid calculus, similar in composition, colour and lustre to the preceding specimen, but it is much smaller, and has somewhat of a reniform figure. Its nucleus consists of an almond-shaped succulent fruit, the skin of which still remains. This concretion was purchased at the sale of the Portland collection in 1786, and was described as "a fine Oriental Bezoar." Vide Plate XVI. figs. 1, 2. *Hunterian.*

Q 3. A nearly similar specimen, the nucleus of which is lost. This calculus has been soaked in linseed oil, in order to keep its layers together. *Hunterian.*

Q 4. A small oval concretion, undivided. Its exterior is highly polished, and is of an olive-brown colour. *Hunterian.*

Q 5. A section of a large Oriental Bezoar, the layers of which adhere together very slightly. Its nucleus is lost, but has evidently been a seed, resembling in appearance a Tonquin bean. *Hunterian.*

Q 6. An undivided Oriental Bezoar of an oblong figure, slightly constricted in the middle: a portion of its outer layers has been removed in order to show the colour of its interior. *Hunterian.*

Q 7. An ellagic acid calculus, similar in figure to the preceding specimen. It has a piece of twig for its nucleus. "From a Goat." *Hunterian.*

Q 8. A nearly similar specimen, likewise "from a Goat." It has a piece of grass for its nucleus. *Hunterian.*

Q 9. An Oriental Bezoar, which has been divided transversely, and its nucleus exposed, in order to show that the calculus has been formed on a small twig, having a leaf-bud at its extremity. *Hunterian.*

Q 10. An oblong Oriental Bezoar, having a piece of wood for its nucleus. *Hunterian.*

Q 11. A nearly similar concretion, undivided; its exterior is of a rich reddish brown colour. *Hunterian.*

Q 12. Three small ellagic acid calculi. Their exterior is of an olive-green colour, and they have a flattened oval figure. One of these calculi has been broken across, and exhibits the remains of a seed as its nucleus.
Hunterian.

Q 13. Two small irregularly-shaped concretions, one of which has been broken across. They consist principally of ellagic acid; the broken calculus has a small twig for its nucleus. *Hunterian.*

Q 14. A small reniform concretion, consisting principally of ellagic acid. It has been divided transversely, and exhibits a very perfect date-seed for its nucleus. The convex side of the calculus is marked by a groove corresponding to that of the seed. In the Sloanian MS. Catalogue it was described as an "East Indian Bezoar, with a centre in it which rattles like an Eagle stone." *British Museum.*

Q 15. Portions of some small "Oriental Bezoars with a straw" (or some other vegetable fibre) "for their nucleus."—*Sloanian MS. Catalogue.*
British Museum.

Q 16. A small irregularly-shaped calculus, consisting principally of ellagic acid. It had the following memorandum in the Sloanian MS. Catalogue:—"Oriental Bezoar from Suratte. Thevenot edit. 1696, p. 20 of Franc Pelsart. Bezoar d'Orient, Biron, p. 191. The best is found with the Tartars of Usbek. The animal is called Bazard, from whence comes by corruption the word Bezoar." *British Museum.*

Q 17. Three small Oriental Bezoars. The nucleus of one apparently consists of the seed of a species of *Tribulus*. Described in the Sloanian MS. Catalogue as "an East Indian Bezoar." *British Museum.*

Q 18. "A Monkey Bezoar, or true East India Bezoar, from the Goat; of an oblong shape, with a long straw or some such like substance in its center; sett, as they generally are for preservation, in a piece of what is called *Lignum lævissimum*, the pulp or medulla of which appears to resemble the common elder."—*Sloanian MS. Catalogue.* Kœmpfer, in his *Amœnitates Exoticæ*, Fasciculus ii. p. 396, has given a drawing of one

of these calculi preserved in the above manner. He states that the calculi are most frequently found in the Dog-headed Baboon, and were most highly valued. The cavity in which the above specimen is preserved is scooped out of the solid wood and lined with raw cotton. It consists of ellagic acid, and has a piece of grass for its nucleus. Vide Plate XVI. fig. 3. *British Museum.*

19. A section of "an East Indian Bezoar, weighing three ounces, two drachms and two scruples. From Mr. Vanhuffe."—*Sloanian MS. Catalogue.* This calculus is exceedingly brittle. It consists almost wholly of ellagic acid, and has a minute nucleus of vegetable fibre. *British Museum.*

CALCULI CONSISTING OF RESINO-BEZOARDIC ACID. (RÉSINE ANIMALE BEZOARDIQUE, *Fourcroy and Vauquelin*: LITHOFELLINSAURE, *Goëbel*: THE OCCIDENTAL BEZOAR.

The concretions to which the above names have been applied, are readily distinguished from all others by possessing the easy fusibility and general characters of a resin. In the Sloanian and Hunterian MSS. these concretions were described as "*false West Indian Bezoars,*" on the supposition that they were artificial compounds. Their composition, however, and the finely laminated structure they possess, which it would be almost impossible to imitate by art, clearly show that they are genuine Bezoars.

Resino-bezoardic acid calculi are usually of an oval figure. Their external surface is smooth and polished, and has generally a greenish yellow, green, or a light brown colour. They are made up of thin concentric layers, which are frequently of a deeper tint than the exterior. In the centre of the calculus some foreign body is invariably found which forms the nucleus. These calculi are exceedingly brittle; the fracture is conchoidal, and has a resinous lustre. They vary considerably in size, but are usually larger than the ellagic acid species. One specimen in the Museum measures nearly ten inches in circumference. They melt like resin in the flame of a candle, and when more highly heated, give off white vapours which have an aromatic odour, catch fire, burn with a brilliant flame, and leave behind a small shining carbonaceous ash.

Resino-bezoardic acid calculi readily dissolve in alcohol, with the exception of a small quantity of flocculent matter. The alcoholic solution varies in colour in different calculi, but is usually of a red or greenish red tint. The solution gradually deposits small crystals, which, when examined by the microscope, are seen to consist of low six-sided prisms with flattened extremities. When the alcoholic solution is mixed with water, the resin is thrown down. The precipitate appears under the microscope in the form of small crystalline tufts.

Digested in solution of potass these calculi readily dissolve, the solution is of a brownish green colour, and when neutralized by an acid, a thick curdy precipitate is produced, which by agitation adheres together and while warm may be kneaded between the fingers or drawn into threads like cobbler's-wax. The viscidity of this precipitate is owing to another resinous matter which the calculi contain; for the pure resino-bezoardic acid similarly treated forms an amorphous precipitate which cannot be made to adhere together. They dissolve in solutions of ammonia and its carbonate. In concentrated sulphuric acid they also dissolve. The solution is of a red colour, and is rendered turbid by the addition of water. The precipitate is not crystalline, like that from its solution in alcohol, but consists of minute transparent yellow particles. Nitric acid acts with energy upon these calculi, nitrous acid is evolved, and a light red solution is formed, which quickly becomes yellow.

The concretions described by Kœmpfer under the name of *Coagulum Resinosum Bezoarticum* are identical in composition with these calculi; for he says that the Swedish ambassador, on his departure from Ispahan, purchased some specimens, which, when thrown upon burning coals, melted and gave out an aromatic odour like that of colophony or olibanum. He likewise states that they were termed in Persia *Lapis Bezoar Occidentalis*, on account of their similarity to the concretions brought from South America, and which, according to Monardes, were taken from the wild goats of Persia. A figure of the Occidental Bezoar is given in the work of Clusius, which is quite characteristic of the resino-bezoardic acid concretion. It is therefore probable that the true Occidental Bezoar was a resinous concretion, although the same term was often applied to other concretions.

The chemical characters of these concretions appear to have been first in-

vestigated by Fourcroy and Vauquelin. Their account is very slight and imperfect, but is accompanied by a very accurate drawing of a fragment of one of these calculi. Fourcroy states that they are taken from some unknown species of Asiatic or African animals, and rightly conjectures that they are formed from the resinous juices of the plants on which these animals feed*. It is remarkable that since the time of Fourcroy no other investigation of these singular concretions should have been made until the year 1841, when M. Goëbel found a calculus in the Zoological Museum at Dorpat, which was described as "*a gall-stone consisting of concentric layers*," but had no history. From the results of his experiments on this calculus, M. Goëbel concluded that it was a new species of gall-stone consisting of a peculiar acid, to which he gave the name of *litho-fellinic acid*, mixed with a small quantity of albumen and of the yellow colouring matter of the bile†.

Shortly after a similar calculus was found by Professor Wöhler among a collection of pathological specimens at Göttingen. This calculus was also without any history, but from its colour and from its containing matters similar to the colouring matter of the bile, it was conjectured to be a gall-stone from some large foreign animal, although the probability of its belonging to the class of Bezoars is also admitted. It weighed 643 grains, was of an ovate figure, and had a light brownish green colour with a waxy lustre. It consisted of a great number of thin concentric layers which easily separated from each other, and were alternately of a lighter or darker colour, but had not the slightest trace of a crystalline structure. Its nucleus was formed by a thick brown substance, which in most of its properties resembled the rest of the stone, but differed from it in being only partially fusible, and leaving on ignition a yellow alkaline ash, which contained phosphate and carbonate of lime with traces of peroxide of iron‡.

The composition of this species of calculus was carefully examined very shortly after commencing the examination of this Collection, and it was described as an intestinal concretion, in a report addressed to the Museum Committee in January 1841. Subsequent examination has confirmed the former

* *Annales du Muséum National*, tom. iv.

† *Annalen der Chemie und Pharmacie*, B. xxxix.

‡ Poggendorff's *Ann. der Phys. und Chem.*

opinion as to their origin, and they have been arranged with intestinal concretions for the following reasons :—

First. They resemble all other concretions which are known to be found in the intestines by having a foreign body for their nucleus.

Secondly. They sometimes attain a very large size, quite incompatible with the notion of their being biliary concretions. There is one specimen in this collection which measures three inches and a half in length, and the same in its greatest diameter. This calculus is of a rude triangular figure, and has evidently been accompanied by other calculi, as both of its extremities have depressed surfaces. Another is four inches in length by three in breadth.

Thirdly. That they are not derived from any of the natural or altered constituents of the bile which have concreted in the intestine, is proved by their containing a soft vegetable resin, which is incapable of crystallizing, besides other vegetable matters. In addition to this, it may be stated that no unequivocal instance of a biliary concretion being formed in the intestine has hitherto been described.

From a careful analysis that was made of one of these concretions it has been inferred that their principal constituent is a vegetable resin, which is characterized by crystallizing in the form of six-sided prisms; that it is accompanied by a small quantity of a soft resin, probably containing volatile oil; that in addition to these it contains some other substances, as colouring and extractive matter, the precise nature of which it is impossible to determine, but which are doubtless also of vegetable origin. The identity of these calculi with the lithofellenic acid concretions of Prof. Goëbel is fully shown by the similarity of their chemical characters, and also by the very accurate drawing which accompanies the paper of Prof. Goëbel. With regard to the nature of the colouring matter, it is probable that it is not always derived from the bile. In all the calculi that were examined no decided indications could be obtained of the presence of its colouring matter, which was found by Prof. Goëbel in the concretion of which he has given so accurate a description. It is probably only an accidental constituent. The ingredients of the bile are, however, not infrequently present in concretions of admitted intestinal origin: the presence of its colouring matter would therefore be no argument in proof of the biliary origin of these calculi.

Resino-bezoardic acid has been submitted to ultimate analysis by Drs. Ettling

and Will, and also by Prof. Wöhler. Their results are shown in the following table:—

	Ettling and Will.			Wöhler.		
	By Analysis.	By Calculation.	Ats.	By Analysis.	By Calculation.	Ats.
Carbon	71·19	70·80 . .	71·43 = 42	70·83	70·83 . .	= 40
Hydrogen	10·85	10·78 . .	10·63 = 76	10·60	10·48 . .	= 72
Oxygen	17·96	18·42 . .	17·94 = 8*	18·57	18·69 . .	= 8†
	100	100	100	100	100	

The composition of the crystallized acid is therefore regarded by Drs. Ettling and Will as represented by the formula $C_{42}H_{74}O_7+HO$. Prof. Wöhler represents it as $C_{40}H_{70}O_7+HO$, and believes this formula to be the most correct, since it corresponds with that of the other crystalline resins in the number of atoms of carbon.

ℜ. *Resino-bezoardic Acid.*

ℜ 1. A section of a large resino-bezoardic calculus. It measures three inches in length by two and a quarter in breadth, and is composed of thin concentric layers of a greenish-brown colour, surrounding a small twig.
Hunterian.

ℜ 2. An oblong concretion, similar in appearance and composition to the preceding specimen. It measures nearly three and a half inches in length by two and a quarter in breadth. Its nucleus consists of a small mass of vegetable hairs, cellular tissue, spiral vessels, and other vegetable remains.
Hunterian.

ℜ 3. An oval resino-bezoardic calculus, the nucleus of which is lost, but has apparently been some seed. *Hunterian.*

ℜ 4. An undivided concretion, of a nearly circular flattened figure. It consists almost entirely of resino-bezoardic acid. *Hunterian.*

ℜ 5. An entire resino-bezoardic acid calculus, of an irregularly rounded figure.
Hunterian.

* *Ann. der Chem. und Pharm.*, xxxix. 242.

† Poggendorff's *Ann. der Phys. und Chem.*, liv. 259.

℞ 6. A small entire resino-bezoardic acid calculus, of an irregular oval figure. *Hunterian.*

℞ 7. A resino-bezoardic acid calculus, of a regular oval figure, about an inch and three quarters in length. It is composed of concentric layers, varying in tint from dark green to light brown, surrounding what appears to be the remains of a seed. *Hunterian.*

℞ 8. A longitudinal section of a small resino-bezoardic acid calculus, the nucleus of which has been lost. "Lap. Bezoar Coromandel." *Hunterian.*

℞ 9. A flattened oval calculus, composed of concentric layers of resino-bezoardic acid, varying in colour from light brown to dark green; deposited around a small mass of long vegetable hairs. *Hunterian.*

℞ 10. A flattened oval calculus, having a piece of quartz for its nucleus. It consists of resino-bezoardic acid, is of a light brown colour throughout, and differs from the other calculi in having a slightly radiated structure. *Hunterian.*

℞ 11. A large calculus, of an oval figure, which measures nearly four inches in length by nearly three inches in breadth. It consists of resino-bezoardic acid, and has a mass of fine brown animal hairs for its nucleus. *Hunterian.*

℞ 12. An oblong resino-bezoardic acid calculus, having a piece of twig for its nucleus. Its exterior is speckled green and brown.

℞ 13. A fragment of a very compact resino-bezoardic acid calculus. *Hunterian.*

℞ 14. A small undivided calculus, of an oblong figure. *Hunterian.*

℞ 15. A similar calculus, of a rounded figure, flattened on one side. Described in the Sloanian MS. Catalogue as "A false West Indian Bezoar. Lapis Bezoar de Coromandel Seba." *British Museum.*

℞ 16. A small flattened pyriform calculus, consisting of resino-bezoardic acid. Its nucleus is formed by a small twig, immediately surrounding which is

a soft mass, consisting of the substance of the calculus mixed with vegetable hairs. This calculus was described in the Sloanian MS. Catalogue as "A false Bezoar from Turkey. From Mr. Pearle."

British Museum.

℟ 17. A section of a regular oval calculus composed of concentric layers of resino-bezoardic acid surrounding a date-seed. *British Museum.*

℟ 18. A section of a flattened nearly circular calculus, consisting of resino-bezoardic acid, deposited around a mass composed chiefly of animal hairs. Described in the Sloanian MS. Catalogue as "Bezoar occidental."

British Museum.

℟ 19. An oblong calculus, similar in composition to the preceding, having a twig for its nucleus. "False occidental Bezoar."—*Sloanian MS. Catalogue.* *British Museum.*

℟ 20. A nearly globular calculus, considerably broken. Described in the Sloanian MS. Catalogue as "A false bezoar, made of rosin, &c.; it melts with a candle." This calculus is similar in composition to all the preceding specimens, and is doubtless derived from the resinous juices of the plants on which the animal has fed. *British Museum.*

℟ 21. A section of a resino-bezoardic acid calculus, having a piece of clay for its nucleus. *Presented by W. Clift, Esq.*, 1821.

℟ 22. A resino-bezoardic acid calculus, which measures three inches and a half in length. It has the form of an irregularly-shaped three-sided prism, with rounded edges, and both its extremities are concave from having been in contact with other concretions. Its nucleus consists of a small mass of vegetable fibre. *Hunterian.*

℟ 23. A section of a small resinous concretion divided transversely, having a date seed in its centre. *British Museum.*

CALCULI CONSISTING OF PHOSPHATE OF MAGNESIA AND AMMONIA. (TRIPLE PHOSPHATE CALCULUS).

This species of calculus forms the ordinary intestinal concretion of Horses. It is usually found in the stomach, cæcum, or other part of the large intestines, and frequently attains an enormous size. A specimen in this Collection weighs above seventeen pounds, and measures two feet three inches in circumference, and there are several others of scarcely inferior dimensions.

The triple phosphate calculus is easily recognized, when broken, by its crystalline structure; it appears to be made up of broad crystalline plates, which radiate from the centre to the circumference of the calculus. When more closely examined, however, it is seen to possess a laminated structure, the concentric layers being so thin and closely arranged together, that upwards of two hundred have been counted by Mr. J. Quekett in the space of an inch: the laminated structure is most apparent when the calculus is sawn through. The external surface of these calculi is either smooth or crystalline, and of a light brown or grey colour: their interior is generally deep brown, and the fractured surface sometimes exhibits an iridescent appearance, like that of Labrador felspar: thin fragments of the calculus are semi-transparent, but by exposure to the air lose part of their water of crystallization and become opake. This fact is frequently to be observed on the surface of the concretions, which appear coated by a white earthy crust*. These concretions have almost invariably some foreign body for their nucleus, the figure of which determines the general form of the calculus; as they increase in size they always assume more or less of a rounded figure.

In their chemical composition triple phosphate calculi are for the most part very pure. Small quantities of phosphate of lime are generally to be detected, and this salt sometimes amounts to nearly 20 per cent. They also contain a large quantity of animal matter,—an extractive matter, to which the brown colour of the calculus is owing, muriate of soda, and various alkaline salts derived from the intestinal juices. The animal matter resembles that of all other concretions, and separates in concentric laminæ when the calculus is dissolved in an acid. In the more impure varieties, grains of sand, hay and straw

* By some authors this white crust has been described as consisting of sulphate of magnesia and ammonia. In all the specimens that have been examined, it consisted merely of the effloresced triple phosphate.

are frequently found imbedded in the calculus; and there is one specimen in the Museum which contains an entire layer of vegetable hairs.

When heated before the blowpipe, triple phosphate calculi lose their water and ammonia, become white and opake, and by a powerful heat may be fused into an opake enamel, consisting of diphosphate of magnesia. They readily dissolve in the weakest acids, and from the solution ammonia precipitates the salt unchanged in the form of a crystalline powder.

When boiled with solution of potass, ammonia is freely evolved.

Numerous descriptions of these calculi are to be found in the 'Transactions of the Royal Society' and other scientific works. Their composition was first ascertained by Fourcroy and by Bartholdi of Strasburg about the same time. A specimen analysed by Klaproth was found to consist of phosphoric acid 28·, magnesia 17·, ammonia 7·, animal matter 1·, water 47·*.

With regard to the origin of triple phosphate calculi, most authors agree that they are formed from the phosphate of magnesia contained in wheat, oats, hay, &c., and this opinion derives confirmation from the circumstance, that they occur most frequently in millers and brewers' horses which are fed on grains and bran, substances known to contain a much larger proportion of magnesian salts than other vegetable matters.

§. *Phosphate of Magnesia and Ammonia.*

§ 1. The two halves of a large calculus, consisting principally of phosphate of magnesia and ammonia. It has a piece of flint for its nucleus, and was "taken out of the stomach of a miller's Horse at Berkhampstead. From Dr. Woodward's Collection."—*Sloanian MS. Catalogue.*
British Museum.

§ 2. An intestinal concretion of a nearly globular form, which measures six inches and three quarters in diameter. From the Horse. It consists of phosphate of magnesia and ammonia, and contains midway between its

* *Chemische Abhandlungen*, B. vi. 213.

centre and exterior a layer of about half an inch in thickness of the hairs of the oat. *Presented by Sir W. Blizard.*

ℌ 3. A very large heart-shaped concretion, which measures two feet three inches in its greatest circumference, and weighs nearly seventeen pounds avoirdupois. It is composed throughout of phosphate of magnesia and ammonia, mixed with some phosphate of lime. Its external surface is beautifully crystalline, and a small piece of flint forms the nucleus. *Hunterian.*

ℌ 4. An undivided concretion, of an oblate spheroidal figure. It measures two feet four inches in its greater circumference, and weighs nearly eighteen pounds. Its external surface is quite smooth. *Hunterian.*

ℌ 5. A large cylindrical-shaped concretion having smooth flattened surfaces at each extremity. It measures seven inches in length, and contains an iron nail in its centre. Composition similar to the preceding. *Hunterian.*

ℌ 6. A large triple phosphate calculus divided. *Hunterian.*

ℌ 7. A nearly spherical concretion, measuring twenty-two inches in circumference. It consists of crystalline triple phosphate, and has contained vegetable matter. *Hunterian.*

ℌ 8. A large intestinal concretion lobulated on its exterior. It consists of impure triple phosphate. *Hunterian.*

ℌ 9. An intestinal concretion of nearly a globular form, measuring above six inches in diameter. The concentric arrangement of the layers and the radiated structure of the triple phosphate calculus are well shown in this specimen. *Hunterian.*

ℌ 10. A section of a similar but larger calculus. Its exterior is partly coated by a crystalline crust of the triple phosphate. *Hunterian.*

ℌ 11. A similar calculus of a rude conical figure, with a quadrangular base. *Purchased*, 1828.

ℌ 12. An oval concretion, consisting of compact triple phosphate. *Hunterian.*

§ 13. A cubical-shaped calculus, consisting of compact triple phosphate. *Hunterian.*

§ 14. A compact flattened calculus from the intestinal canal of the Horse. *Hunterian.*

§ 15. An oval calculus, consisting of triple phosphate deposited upon a small nail. Its exterior is smooth but crystalline. *Hunterian.*

§ 16. An oval concretion, the exterior of which is singularly lobulated. Triple phosphate. *Hunterian.*

§ 17. A cylindrical calculus, having depressed polished surfaces at each extremity, from having been in contact with other stones. It consists of triple phosphate, which has been deposited around a horse-shoe nail. *Hunterian.*

§ 18. A flattened concretion, similar in composition to the preceding species. *Hunterian.*

§§ 19. 20. 21. 22. Four triple-phosphate concretions, having a rude tetrahedric figure, with unequal sides. *Hunterian.*

§ 23. Four triple phosphate concretions, taken "from the alimentary canal of a Horse, which was opened at Messrs. Tattersall's, August 1789."

No. 1. The smallest, of a flattened triangular figure, was taken out of the stomach.

Nos. 2 and 3. Of a tetrahedric figure, were taken from the colon.

No. 4. Of a cylindrical shape, flattened at both ends, was taken from the rectum, at about eighteen inches from the anus. *Hunterian.*

§ 24. Four intestinal concretions taken from a Horse. They are similar in form and composition to the preceding specimens, but are much smaller. *Hunterian.*

§ 25. Four large intestinal concretions, which were doubtless taken from the Horse. One of these concretions is of a flattened circular figure, having a deep circular excavation on one of its sides, which has probably been filled with excrement. *Hunterian.*

§ 26. A large triple phosphate calculus, of a rounded cubical figure. It was accompanied by a memorandum in Dutch, stating it to have been taken from a Japanese wild Horse. *Hunterian.*

§ 27. A globular triple phosphate concretion, from the intestinal canal of a Horse. *Presented by Wm. Gaitskell, Esq.*, 1810.

§ 28. A section of a large triple phosphate calculus, polished.
British Museum.

§ 29. A similar calculus, of large size and of a rude cubic figure, with rounded edges and angles. It has a nail for its nucleus. *British Museum.*

§ 30. The two halves of a large and singularly-shaped intestinal calculus, said to be from the stomach of a Horse. This concretion is of an oblong figure, and about its middle is a deep groove, which gives it the appearance of being formed of two unequally-sized calculi united together. Its extremities are smooth and polished, and the exterior is in many places deeply pitted. Phosphate of magnesia and ammonia deposited around a large nail. *Presented by Dr. Power*, 1821.

§ 31. An oval triple phosphate concretion, having a smooth external surface.
Hunterian.

§ 32. A spherical concretion, consisting of crystalline triple phosphate, and having a very dark-coloured granular exterior. It has a piece of flint for its nucleus. *Hunterian.*

§ 33. A triple phosphate concretion, of a nearly globular figure.
Hunterian.

§ 34. An oval concretion, undivided, similar in composition to the preceding specimen. *Hunterian.*

§ 35. A portion of a similar concretion. *Hunterian.*

§ 36. } Two small triple phosphate concretions, having a piece of flint in their
§ 37. } centres; apparently taken from the same animal. *Hunterian.*

§ 38. A small, triangularly-shaped triple phosphate concretion. *Hunterian.*

℘ 39. An oblong concretion, consisting of triple phosphate, and having a horse-shoe nail for its nucleus. *Hunterian.*

℘ 40. An egg-shaped triple phosphate calculus. *Hunterian.*

℘ 41. A large spherical, triple phosphate calculus, with 112 small concretions. From the intestinal canal of the same horse.

Presented by Sir J. Banks.

℘ 42. A very large triple phosphate concretion, of a rounded quadrilateral figure. It has a small fragment of flint for its nucleus.

Hunterian.

℘ 43. A smaller calculus, having also a rude quadrilateral figure. It has a nail in its centre. *Hunterian.*

℘ 44. A large spherical concretion, said to have been taken from the alimentary canal of an Elephant. It consists of triple phosphate, which at the centre is highly crystalline.

Presented by Wm. Bullock, Esq., 1815.

℘ 45. A considerable number of small flattened concretions, taken from the intestinal canal of a Horse. They consist of triple phosphate, and their external surface is eroded, as if partially dissolved.

Presented by Sir Wm. Blizard, 1813.

℘ 46. Half a small triple phosphate calculus. *Hunterian.*

℘ 47. } Small intestinal concretions, consisting of phosphate of magnesia and
℘ 48. } ammonia, with phosphate of lime. *Hunterian.*

℘ 49. Fragments of the exterior of a large intestinal concretion.

Hunterian.

℘ 50. A broken triple phosphate calculus. *Hunterian.*

℘ 51. The half of a small oval concretion, consisting principally of triple phosphate, deposited around a nail. *Hunterian.*

§ 52. Several small concretions, principally consisting of triple phosphate. Some of them are deposited upon a nucleus of flint, and one upon the head of a brass chair-nail. *Hunterian.*

§ 53. A small broken intestinal calculus, which was "voided by a Horse."—*Sloanian MS. Catalogue.* *British Museum.*

§ 54. A nearly circular triple phosphate calculus, surrounding a piece of iron. *Hunterian.*

§ 55. Twenty-two irregularly-shaped triple phosphate concretions, taken from the intestines of a Horse. The broken surface of some of these concretions presents an iridescent appearance like Labrador felspar.
Presented by Sir Wm. Blizard, 1807.

§ 56. Triple phosphate calculus, deposited upon a piece of iron. *Hunterian.*

§ 57. An oval-shaped concretion, consisting principally of triple phosphate, deposited upon a nail. The surface of this calculus is eroded in parts as if it had been submitted to the action of an acid. *Hunterian.*

§ 58. The two sections of a compact triple phosphate concretion, having a flint pebble for its nucleus. *Hunterian.*

§ 59. Fragments of an intestinal calculus, consisting of phosphate of magnesia and ammonia, with some phosphate of lime. *Hunterian.*

§ 60. A small flattened oval calculus, from the Horse. *Hunterian.*

§ 61. } Two polygonal-shaped concretions, consisting of phosphate of magnesia
§ 62. } and ammonia with a little phosphate of lime. Large crystals of the triple phosphate form the centre of each. One of these calculi is figured in Plate XIV. fig 2. *British Museum.*

§ 63. Several small irregularly-shaped triple phosphate concretions, from the colon of a Horse. *Presented by G. Langstaff, Esq.*

℔ 64. A very large intestinal calculus, taken from a Horse slaughtered in Cow Cross, Smithfield. It consists partly of triple phosphate and partly of undigested vegetable fibre, principally the setæ of the oat-seed.

Purchased, 1824.

℔ 65. A globular triple phosphate calculus, taken from the stomach of a miller's horse. It weighs above seventeen pounds.

Presented by Thomas Cam, Esq., 1845.

CALCULI CONSISTING OF DIPHOSPHATE OF MAGNESIA.

This species of calculus is distinguished from all other concretions by its singularly tuberculated exterior, and by the beautiful appearance of its section, which in variety of tints, transparency and general aspect, closely resembles some kinds of agate. It is made up of semi-transparent layers of various shades of a light-brown or yellow colour, alternating with white opake layers; these are arranged in undulating circles around the nucleus, which usually consists of some vegetable substance: the concentric layers are intersected by crystalline needles radiating from the centre to the circumference of the calculus, and which also vary in colour and transparency. Its exterior is smooth, but highly tuberculated; the tubercles consist of broad crystalline plates lying one over the other. Some of these calculi are exceedingly brittle, and readily separate into concentric layers about a sixth of an inch in thickness: irregular deposits of phosphate of lime are generally to be observed ramifying between the concentric and diverging layers of the calculus, as shown in Plate XIV. fig. 5.

The phosphate of magnesia calculus is of much rarer occurrence than either the triple phosphate or the phosphate of lime concretion. It is generally of a globular figure, and seldom exceeds three inches in diameter: it usually contains a small quantity of phosphate of lime, to which the whiteness of its layers is probably owing. Animal matter is always present, but apparently in smaller quantity than in most other intestinal calculi.

When heated before the blowpipe this calculus becomes white and opake, chars, and by a very great heat may be fused into a white enamel. It readily dissolves in the diluted acids, with the exception of a small quantity of animal matter, and the addition of ammonia causes an abundant precipitate of phosphate

of magnesia and ammonia. Fourcroy and Vauquelin appear to have been the only chemists who have examined this concretion; their description is very short and imperfect, and they did not ascertain the proportion of its constituents *. 19·52 grains of a specimen in this collection, after being heated red-hot, dissolved in muriatic acid, and freed from lime by the addition of oxalate of ammonia, gave with ammonia a crystalline precipitate of triple phosphate which when calcined weighed 17·24 grains. The same calculus was found to consist per cent. of—

Diphosphate of magnesia	56·86
Diphosphate of lime with a trace of the oxides of manganese and iron	7·00
Water and animal matter	35·62
Loss	00·52
	100·00

As part of the water belongs to the diphosphate of lime, which as will be shown hereafter, contains 4 equivalents of water, 1·54 of water should be subtracted from 35·62; and if the animal matter be estimated at 1· per cent. the quantity of water combined with the phosphate of magnesia will be reduced to 33·08, which is nearly in the atomic proportion of 7 to 1. Consequently these concretions consist of 1 atom of diphosphate of magnesia combined with 7 atoms of water†. When the calculus is dried at a temperature of 212°, 5 atoms of water are driven off; by a red heat the whole is expelled.

From what animals these concretions were taken we have not been able to obtain the slightest information. Many of the specimens were described in the Hunterian and Sloanian MSS. as Rhinoceros Bezoars, but Sir Anthony Carlisle assured Mr. Clift that there was not the slightest reason for supposing that they were taken from that animal, and that they were so called simply on account of the resemblance which their scaly and tuberculated exterior was supposed to bear to the folds of the skin of the Rhinoceros.

* *Annales du Muséum National*, tom. iv.

† The phosphate of magnesia which is thrown down on mixing saturated solutions of phosphate of soda and sulphate of magnesia contains 14 equivalents of water.—Berzelius, *Lehrbuch der Chemie*.

𝕿. *Diphosphate of Magnesia.*

𝕿 1. A large globular calculus, consisting principally of diphosphate of magnesia. Described in the Sloanian MS. Catalogue as a Rhinoceros Bezoar. Its analysis is given at p. 249. *British Museum.*

𝕿 2. A similar calculus divided and polished; it is figured in Plate XIV. fig. 3, and has the compact structure, semi-transparency, and beautifully variegated appearance of some varieties of agate. *Hunterian.*

𝕿 3. A nearly spherical concretion undivided, consisting of diphosphate of magnesia; its surface is very irregular, from the deposition of broad scaly-looking masses. *Hunterian.*

𝕿 4. An oblong concretion, consisting of concentric layers of diphosphate of magnesia surrounding a piece of twig: described in the Hunterian MS. as a "Rhinoceros Bezoar." *Hunterian.*

𝕿 5. An intestinal concretion, composed of diphosphate of magnesia surrounding two excentric nuclei of phosphate of lime upon a piece of wood; its exterior is covered with small flattened tubercles. *Hunterian.*

𝕿 6. A very irregularly-shaped concretion composed of diphosphate of magnesia deposited upon a piece of leather or horn; its surface is slightly tuberculated. "Rhinoceros Bezoar."—*Sloanian MS. Catalogue.* *British Museum.*

𝕿 7. An undivided calculus, the exterior of which exhibits in a very marked manner the scaly appearance characteristic of the diphosphate of magnesia calculus. *British Museum.*

𝕿 8. A similar calculus divided; its nucleus consists of an acorn. *British Museum.*

𝕿 9. A "Rhinoceros Bezoar," the nucleus of which is composed of the remains of some seed. *British Museum.*

℄ 10. A section of an intestinal concretion, consisting of diphosphate of magnesia surrounding a piece of pebble. *British Museum.*

℄ 11. A large diphosphate of magnesia concretion, the nucleus of which consists of some decayed vegetable matter; it is of an irregular rounded form, and measures about two inches and a half in diameter. "Rhinoceros Bezoar, with very large knobs. From Dr. Waldo."—*Sloanian MS. Catalogue.* *British Museum.*

℄ 12. Section of a similar calculus, the nucleus of which is lost. *British Museum.*

℄ 13. An undivided calculus, of a nearly globular figure, consisting of diphosphate of magnesia. *British Museum.*

℄ 14. A section of a similar calculus, having a piece of pebble in its centre. Its exterior is figured in Plate XIV. fig. 4. *British Museum.*

℄ 15. A section of a calculus, consisting of diphosphate of magnesia. *Presented by W. T. Brande, Esq.*, 1843.

CALCULI CONSISTING OF DIPHOSPHATE OF LIME.

The description which Dr. Wollaston has given of the external characters of the bone-earth urinary calculus, will equally apply to the following intestinal concretions.

These concretions are usually of an oval figure, their exterior is of a light brown colour, smooth, and sometimes polished; when divided they present a regular laminated structure, the layers usually adhering so slightly to each other that they are readily separated into concentric crusts, which vary in thickness from a twentieth to a quarter of an inch. Each concentric layer is composed of an assemblage of fine crystalline needles, which radiate from the centre to the circumference of the calculus, so as to give it when broken a beautifully striated appearance. This species never attains so large a size as the triple phosphate calculus: the largest specimen in the Museum measures four inches

in length by three and a half across. The nucleus always consists of some foreign body.

Diphosphate of lime calculi fuse with difficulty into an opake white enamel; but if phosphate of magnesia be also present they fuse with much greater ease. They readily dissolve in muriatic and nitric acids: the solution behaves towards reagents precisely like an acid solution of the earth of bones. When diluted and mixed with oxalate of ammonia a precipitate of oxalate of lime takes place; and if the solution be afterwards neutralized by ammonia, in order to throw down any oxalate of lime that might have been dissolved, filtered and then evaporated to dryness, and the dry salt heated to redness in a platina crucible, glacial phosphoric acid is left, which is readily recognised by its solution, previously neutralized by an alkali, affording a yellow precipitate with nitrate of silver and a white precipitate with solutions of lead. The latter precipitate, when fused before the blowpipe, gives a bead which crystallizes on cooling, a property characteristic of phosphate of lead. Water digested with these concretions acquires an acid reaction, and phosphate of lime is found in solution. This circumstance arises from the diphosphate of lime being partially decomposed into an insoluble subphosphate and a soluble superphosphate of lime*. Even when the powder of the calculus is placed upon moistened litmus paper, the paper becomes almost immediately reddened. Fourcroy and Vauquelin, who first described these calculi, noticed the above fact; and as they did not ascertain their exact composition, fell into the error of regarding them as composed of an acid or superphosphate of lime,—"*phosphate acidule de chaux*†."

A well-marked specimen of one of these calculi being submitted to analysis, gave—

Diphosphate of lime	76·60
Diphosphate of magnesia . . .	0·84
Water	21·02
Organic matter	1·42
	99·88

* Diphosphate of lime prepared by adding a solution of phosphate of soda to one of chloride of calcium in excess undergoes a similar decomposition.

† *Annales du Muséum National*, tom. iv.

23·83 grains of the calcined calculus abstracting the small quantity of phosphate of magnesia when dissolved in an acid and precipitated by oxalate of ammonia gave 18·93 of carbonate of lime, which = 23·80 of diphosphate of lime.

21·02 water, and 76·60 diphosphate of lime, are nearly in the proportion of four atoms of water to one of the earthy salt*.

Hence this calculus consists of an atom of diphosphate of lime combined with four atoms of water, and its formula will be $2\,CaO + P_2O_5 + 4\,aq$. It differs therefore from the concretions found in the ureter of the Sturgeon by containing one atom less of water.

The relative proportion of phosphoric acid and lime in these concretions has also been determined by E. A. Scharling, who found that when 1·018 gramme of the calcined calculus were dissolved in muriatic acid, and the solution precipitated by a mixture of sulphuric acid and alcohol, 1·087 gramme of sulphate of lime were thrown down, which are = to 1·0169 of the neutral phosphate of lime†.

These concretions appear to have been most commonly found in animals of the Deer species. In the Sloanian MS. Catalogue they are termed Occidental or West Indian Bezoars. There are however specimens in the Museum brought from Ceylon and the Cape of Good Hope.

U. *Diphosphate of Lime.*

U 1. An undivided calculus, described in the Sloanian MS. Catalogue as "A very large Occidental Bezoar in the shape of a kidney. Given to me by Mr. Burnett, who had it at Puerto-belo." Its analysis is given at p. 252.
British Museum.

U 2. An oblong calculus, taken "from the stomach of La Paca." This calculus has been divided, and is figured in Plate XV. figs. 5, 6. It consists of diphosphate of lime, water, and organic matter mixed with a smaller

* The quantity of water should be 21·40, but from the calculus containing organic matter its exact determination is difficult. 31·11 grains of the calculus when dry lost by calcination 6·98, which = 22·44 per cent. of water and animal matter destroyed.

† *De Chemicis Calculorum Vesicariorum rationibus.*

proportion of diphosphate of magnesia than in the former specimen. Its section beautifully exhibits the radiated and laminated structure characteristic of these concretions. It has a small twig in its centre.

Presented by William Bullock, Esq., 1813.

U 3. A large irregularly-shaped calculus, precisely similar in structure and composition to the preceding specimens; it has a piece of wood for its nucleus. *Hunterian.*

U 4. A very regular flattened oval calculus. Its nucleus is lost, but has apparently been a nail. *Hunterian.*

U 5. An irregular triangularly-shaped concretion, having a mass of coarse vegetable matter for its nucleus. *Hunterian.*

U 6. Eight irregularly-shaped concretions, described in the Hunterian MS. Catalogue as "Bezoars, South America, said to be from the Deer." *Hunterian.*

U 7. Half of a small diphosphate of lime concretion, broken transversely. *Hunterian.*

U 8. A flattened oval calculus; its exterior is smooth and polished, and its concentric layers have been deposited around two separate nuclei. *Hunterian.*

U 9. Three small undivided diphosphate of lime calculi. *Hunterian.*

U 10. A small kidney-shaped calculus, composed of layers of diphosphate of lime, deposited around two separate nuclei, between which is a small mass of coarse vegetable fibre. *Hunterian.*

U 11. A mass of hay or dried vegetable fibre coated with diphosphate of lime. *Hunterian.*

U 12. A pyramidal calculus with a quadrangular base, having a piece of twig for its nucleus. *Hunterian.*

U 13. A small egg-shaped concretion, having a piece of twig for its nucleus. *Hunterian.*

U 14. A very regular oval-shaped calculus, consisting of diphosphate of lime deposited on a piece of clay; its surface is smooth and polished, and exhibits marks of having been mounted as an amulet. *Hunterian.*

U 15. A small oval calculus, consisting apparently of two separate calculi united together by a subsequent deposit; it contains some vegetable fibre and a piece of wood for its nucleus. *Hunterian.*

U 16. A similar specimen. *Hunterian.*

U 17. A small oval calculus, consisting of diphosphate of lime. *Hunterian.*

U 18. An oblong diphosphate of lime calculus concretion, having a piece of wood for its nucleus. *Hunterian.*

U 19. A large oval, flattened calculus, consisting of diphosphate of lime arranged in radiating fibres and concentric layers around two separate nuclei. *Hunterian.*

U 20. An irregularly-shaped calculus, consisting of concentric layers of diphosphate of lime surrounding a piece of twig. *Hunterian.*

U 21. A large flattened calculus, consisting of diphosphate of lime, surrounding a small nucleus of vegetable fibre. It readily separates into concentric crusts of about a quarter of an inch in thickness. *Hunterian.*

U 22. A flattened, irregularly-shaped calculus, having a piece of mica-slate for its nucleus. *Hunterian.*

U 23. A small oval calculus, which has formed around a piece of twig. *Hunterian.*

U 24. A nearly circular, flattened bezoar, consisting of diphosphate of lime, and having a piece of hæmatite or native oxide of iron in its centre. *Hunterian.*

U 25. A diphosphate of lime calculus, of a very irregular shape, apparently from having been accompanied by other concretions. *Hunterian.*

U 26. A very irregularly-shaped concretion, composed of diphosphate of lime deposited around a twig. *Hunterian.*

U 27. An undivided calculus, consisting of diphosphate of lime. *Hunterian.*

U 28. A similar concretion divided, having two separate nuclei. *Hunterian.*

U 29. A small oval calculus, having an irregular nucleus of vegetable fibre and a piece of twig. *Hunterian.*

U 30. Several small irregularly-shaped concretions, consisting of diphosphate of lime, having small twigs for their nuclei. *Hunterian.*

U 31. A diphosphate of lime calculus, of a flattened triangular figure. Each of its flattened sides is depressed from having been in contact with other concretions. Its structure is less compact and more earthy than these concretions usually are, but it does not differ from them in composition, and contains some phosphate of magnesia. *Hunterian.*

U 32. A triangular-shaped concretion, the structure of which is earthy, like that of the preceding specimen. It consists principally of diphosphate of lime. *Hunterian.*

U 33. A small, very compact calculus, having a piece of slate for its nucleus. *Hunterian.*

U 34. A section of an intestinal concretion, exhibiting in every respect the characters of the diphosphate of lime calculus. Its nucleus consists of a fine twig. *Mus. Leverian.*

U 35. A diphosphate of lime calculus, having a twig for its nucleus. Described in the Sloanian MS. Catalogue as "A large false bezoar. From Dr. Sam. Brown." *British Museum.*

U 36. A small oval calculus of diphosphate of lime, surrounding a piece of clay. Described in the Sloanian MS. Catalogue as "Bezoar Cervi." *British Museum.*

U 37. An egg-shaped calculus, consisting of diphosphate of lime deposited around a siliceous pebble. Described in the Sloanian MS. Catalogue as "A very large white West Indian Bezoar. Bezoar de Guinea. Seba." *British Museum.*

U 38. A large intestinal calculus, of a rude triangular figure, having a twig in its centre. Described in the Sloanian MS. Catalogue as "An Elephant Bezoar, triangular by rubbing against others." *British Museum.*

U 39. An intestinal calculus, consisting of diphosphate of lime; it is of a flattened figure, and has a piece of slate in its centre. This concretion was brought from Patagonia, where it was stated to have been taken from the head of a Lama, and was supposed by the natives to possess the power of relieving fainting when taken in *cold* water.

Presented by H. Miller, Esq.

U 40. A very flat oval calculus, taken out of the stomach of a Deer in the island of Ceylon. It is composed of diphosphate of lime mixed with a little phosphate of magnesia; its structure is less laminated than these calculi usually are. *Presented by Thos. Keate, Esq.*

U 41. A small, very regularly-shaped oval calculus, similar in structure and composition to the preceding specimen. *British Museum.*

U 42. A mass of vegetable fibre, surrounded by a layer of diphosphate of lime. *Hunterian.*

U 43. An oval calculus, consisting almost entirely of diphosphate of lime, having a piece of slate for its nucleus. *Hunterian.*

U 44. A small irregularly-shaped calculus, composed of diphosphate of lime. *Presented by Thos. Keate, Esq.*

U 45. A section of an irregularly-shaped diphosphate of lime calculus, having an eccentric nucleus. *Mus. Leverian.*

U 46. An irregularly-shaped diphosphate of lime calculus. Described in the Sloanian MS. Catalogue as an "Occidental or West Indian Bezoar, conglomerated, many small ones together. From Mr. Vantruffe." *British Museum.*

U 47. A similar specimen to the preceding, also described as an Occidental Bezoar. *British Museum.*

U 48. A diphosphate of lime calculus, having the form of a three-sided prism. *British Museum.*

U 49. Several small calculi, composed of diphosphate of lime. "Buenos Ayres Bezoars." *British Museum.*

U 50. Half of a large oblong calculus, broken transversely. *Hunterian.*

U 51. Fragments of a diphosphate of lime calculus, which encrusted a mango-seed, portions of which still remain. *British Museum.*

U 52. An oval calculus, consisting principally of diphosphate of lime, which has been deposited upon apparently pieces of leather.

Leverian Museum.

U 53. A large irregularly-shaped calculus, composed of diphosphate of lime.

Leverian Museum.

U 54. A small calculus. Described in the Sloanian MS. Catalogue as "A Bezoar within a pouch." It is composed of diphosphate of lime, and has been preserved in the pouch which forms the nest of the *Aranea Avicularia.* *British Museum.*

U 55. A portion of a diphosphate of lime calculus, the layers of which exhibit a pseudo-metallic lustre. Vide PlateXV. fig. 4. *British Museum.*

U 56. Some small irregularly-shaped phosphate of lime calculi. "Occidental Bezoars."—*Sloanian MS. Catalogue.* *British Museum.*

U 57. An egg-shaped hollow calculus, from the alimentary canal of a Deer. It is composed of diphosphate of lime which has been deposited upon the acorn of the *Quercus Ægilops.* *Presented by John Abernethy, Esq.*

U 58. An elongated oval bezoar, taken from a species of antelope. Cape of Good Hope. It consists of diphosphate of lime, surrounding a small fragment of flint. *Presented by Dr. Stanger,* 1845.

CALCULI CONSISTING PRINCIPALLY OF OXALATE OF LIME.

Concretions evidently of intestinal origin have been discovered in this Collection, composed either of pure oxalate of lime or of oxalate mixed with carbonate of lime. This fact, which was announced in the first part of this Cata-

logue, published in 1842, has since been confirmed by M. Guibourt in a paper read before the Academy of Sciences at Paris in 1843.

Oxalate of lime calculi resemble all other concretions in possessing a laminated structure; their texture however is so dense and compact that the concentric layers cannot be separated from each other. They do not possess the radiated crystalline structure of phosphate of lime or triple phosphate concretions, although they have an indistinct appearance of lines radiating from the centre. Their exterior is usually crystalline, but does not put on the irregular tuberculated appearance characteristic of the concretions from the urinary bladder. They are generally of a globular or oval figure, and both within and without are of a light yellow or dirty white colour. The above characters apply more particularly to the concretions consisting of pure oxalate of lime. Those which contain carbonate of lime are less regularly laminated and much looser in texture. Vide Plate XV. figs. 1, 2, 3.

The composition of these concretions is shown by the following analysis of a very pure specimen in this Collection. 37·40 grains, when dried at a temperature of 240° Fahr., lost 2·06 of water. The dried powder was digested in strong acetic acid, which acquired a yellow colour, but no apparent solution took place. The acid liquor gave no precipitate with ammonia, and only a faint precipitate with oxalate of ammonia; being evaporated to dryness a small quantity of sulphate of lime was left behind. The insoluble residue dissolved entirely in nitric acid with a bright yellow colour, and a copious white precipitate was thrown down by the addition of ammonia. The precipitate was digested while moist with concentrated acetic acid, and collected upon a filter; when dry it weighed 35·25 grains. The greater part of this precipitate was boiled for a considerable time with a dilute solution of carbonate of potass, the liquid filtered, and to the clear solution nitrate of lead was added; a copious precipitate of oxalate and carbonate of lead was thrown down, which, after repeated washings, was diffused through water and decomposed by sulphuretted hydrogen. The liquor, when freed from sulphuret of lead, yielded on evaporation long prismatic crystals of oxalic acid. Another portion of the precipitate being calcined in a platina crucible, left a residue consisting wholly of carbonate of lime.

Hence this calculus consists of 94·25 per cent. of oxalate of lime, 5·50 water, and 0·25 sulphate of lime. Another concretion was found to consist of oxalate

of lime with a minute quantity of yellow colouring, and animal matter 66·48, carbonate of lime 29·27, water 2·95, phosphate of lime with a trace of peroxide of iron 1·30.

It is probable that these concretions are formed from the oxalate of lime or alkaline oxalates contained in many plants. All the concretions in the Museum have a nucleus of vegetable fibre which was submitted to microscopic examination by Dr. F. Farre, but without his being enabled to recognise the plant from which it was derived. In the Sloanian MS. Catalogue these concretions are termed Elephant Bezoars, and it is not improbable that some of them were taken from that animal.

W. *Oxalate of Lime.*

W 1. "An Elephant Bezoar."—*Sloanian MS. Catalogue.* This concretion is of a flattened globular figure, and measures nearly five inches in diameter. Its exterior has been polished. It consists per cent. of oxalate of lime 94·25, water 5·50, sulphate of lime 0·25. The nucleus is formed by a mass of vegetable fibre. *British Museum.*

W 2. A concretion similar in composition and figure to the preceding specimen, but smaller. Its exterior is crystalline, and its nucleus consists of undigested vegetable fibre and hairs. Vide Plate XV. fig. 3. *British Museum.*

W 3. A section of an oxalate of lime concretion, which measures four inches in diameter, and has a nucleus of vegetable fibre. Its exterior is crystalline. "An Elephant's Bezoar."—*Sloanian MS. Catalogue.* *British Museum.*

W 4. A small oval calculus, the surface of which is studded with the summits of crystals apparently of a rhombic figure. This calculus was arranged by Mr. Hunter among the human urinary concretions, but its having a nucleus of vegetable fibre shows that it is a Bezoar. It consists of nearly pure oxalate of lime. Vide Plate XV. figs. 1, 2. *Hunterian.*

W 5. A large oblong concretion surrounding a mass of vegetable fibre. It

consists per cent. of oxalate of lime 66·48, carbonate of lime 29·27, water 2·95, phosphate of lime, with a trace of peroxide of iron, 1·30. It is less regularly laminated, and much less compact in texture than the preceding specimens. *British Museum.*

AMBERGRIS. THE CONCRETE MATTER FOUND IN THE ALIMENTARY CANAL OF THE SPERMACETI WHALE.

This substance is usually found floating on the sea near the coasts of India Africa, and South America. It is in the form of amorphous masses, having a peculiar odour, soft and unctuous to the touch, and of a greyish black colour, mottled with greenish white or brown spots. A great variety of opinions have been entertained as to the origin of ambergris. It is however now well ascertained that it is a morbid product formed in the intestines of the Spermaceti Whale, *Physeter macrocephalus*.

Ambergris consists principally of an inodorous crystalline fatty matter, termed Ambrein, mixed with a yellow oil and a small quantity of extractive matter containing benzoic acid and chloride of sodium. The horny beaks of the Squid, *Sepia moschata*, on which the Sperm Whale feeds, are often found imbedded in its substance, and it is supposed that its peculiar odour is derived from the Squid.

Ambrein resembles cholesterine in all its principal chemical characters. It is not saponified when acted upon by alkalies, is readily soluble in alcohol and ether, and yields a peculiar acid, termed *Ambreic acid*, by the action of nitric acid. The proportions of its ultimate constituents are also nearly the same as those of cholesterine.

By most writers of the present day ambergris is considered to be the fæces of the Whale altered by disease. Mr. F. D. Bennett says that "it is a morbid concretion in the intestines of the Cachalot, deriving its origin either from the stomach or biliary ducts, and allied in its nature to gall-stones or to the bezoars of herbivorous animals; while the masses found floating on the sea are those that have been voided by the Whales, orliberated from the dead animal by the process of putrefaction *.

* Narrative of a Whaling Voyage round the Globe, 1840.

The great analogy which ambrein bears to cholesterine would however incline us to the opinion that it is a product of the biliary organs, in which case it would be properly classed among biliary concretions.

ℨ. *Ambergris.*

ℨ 1. A section of a large rounded mass of ambergris, having an indistinct lamellar structure. *Hunterian.*

ℨ 2. A similar but smaller mass divided. *Hunterian.*

ℨ 3. A small portion of ambergris. *Hunterian.*

ℨ 4. A portion of ambergris superior in quality to the preceding specimens. *Purchased,* 1845.

PART III.

THE concretions described in this part of the Catalogue comprehend those unorganized substances found in the joints, veins, bronchi, lachrymal ducts or other parts of the living body which could not be included in the two former parts of the Catalogue. Concretions of this class rarely possess a laminated character or any definite structure, and, with the exception of the gout-concretion, they invariably consist of phosphate with carbonate of lime.

DIVISION I.

CONCRETIONS FROM THE LACHRYMAL DUCT OF MAN.

These concretions are not of very common occurrence. According to Fourcroy they consist of phosphate and carbonate of lime. There are no specimens of the kind in the Museum.

CONCRETIONS FROM THE LUNGS OR BRONCHI OF MAN.

Pulmonary concretions are generally composed of phosphate and carbonate of lime, with a large quantity of a dense membranous matter. Dr. Henry found one of these concretions to contain 20 per cent. of phosphate of magnesia and ammonia *.

* Thomson's Ann. 15, 116.

β. 1. A stone spit out of a woman's lungs. From Dr. Grew's Collection.—*Sloanian MS. Catalogue.* Phosphate and carbonate of lime.
British Museum.

CONCRETIONS FROM THE JOINTS, ETC. OF MAN.

The composition of gout or chalk-stones was first determined by Dr. Wollaston in 1797, who found them to consist of suburate of soda. Many of these concretions contain a large quantity of phosphate and carbonate of lime, and in some cases these earthy salts form the principal constituent.

Gout Concretions.

γ 1. Small masses of urate of soda. *Hunterian.*

γ 2. A mass of phosphate of lime with carbonate of lime and some urate of soda, surrounded by a thick membranous coat. "Bunner's gout-stones." —*Hunterian MS.* *Hunterian.*

γ 3. A small mass of urate of soda from a gouty patient.
Presented by Anthony White, Esq., 1836.

γ 4. The first phalanx of the bones of the great toe, on the upper surface of which is a mass of gouty deposit, consisting of urate of soda mixed with a large quantity of phosphate of lime. *Museum Heaviside.*

CONCRETIONS FROM THE VEINS OF MAN, *Phlebolites.*

Concretions from the veins are invariably composed of phosphate and carbonate of lime. They are of very common occurrence, but there are no specimens in the Museum.

Division II.

There are no specimens in the Museum of concretions from the lungs, lachrymal duct or veins of the lower animals.

CASTS OF CALCULI.

1. A coloured cast of a large and very irregularly formed calculus.

Hunterian.

"The stone, of which this is the exact model in plaster of Paris, was extracted from a gentleman aged 86, after having been most grievously afflicted with it during twenty years. The concavity No. 1 was formed upon a scirrhous tumour situated internally upon the left side of the neck of the bladder, and which an assistant with his fingers depressed during the operation, in order to facilitate the extraction, which was rendered extremely difficult, not so much on this account, or of the stone's bulk, but its irregular shape, and the face No. 1 presenting to the orifice. The protuberance No. 3 was, immediately upon the extraction, from the dotted lines to its apex, of a flesh-colour, as if drawn out of a cavity in the bladder; into which the tumour situated at its neck, by gradually increasing, had formed the cup No. 1, and most certainly thrust it. The numbers 2. 2. are where the forceps laid hold, and on one side a scale is broken off by them at No. 4.

"The gentleman survived the operation but a few hours.

"P.S. My friend Mr. Todd, who opened the body, wrote me that 'he found the bladder much contracted, its coats thickened and become almost scirrhous; and the tumour, which seemed to retard the extraction of the stone, was scirrhous, about the size of a common egg, and something of the kidney shape, seated in the posterior part, and close to the neck of the bladder, contiguous to, and on the left side of the prostate gland, which appeared sound, and of its natural size:—the basis of the stone resting upon the tumour, and its point evidently attached to the

superior part of the bladder, fixed it, as it were, at both ends ; which, together with the irregular and uncommon form of the stone, makes one not wonder at the difficulties encountered in fixing the forceps as well as in extracting the stone.' "

2. " A plaster of Paris cast, of an extraordinary calculus, taken from the urinary bladder of Mr. Charles Noble of Canterbury after death. A piece has been broken off from one end, which corresponded to the neck of the bladder ; it is said to have weighed seventeen ounces when first taken from the patient. About a teacupful of small calculi were taken out at the same time. See Gentleman's Magazine, 1785."

Hunterian.

3. Four casts of vesical calculi. *Hunterian.*

4. A coloured cast of a very large calculus from the human urinary bladder. It measures 15 inches in its greatest circumference and 11·7 in its least. According to the analysis of Professor Cumming, it consists principally of uric acid deposited upon an oxalate of lime concretion having a small nucleus of uric acid, its exterior being coated with a thin crust of the fusible calculus. The calculus is preserved in the Museum of Trinity College, Cambridge. *Presented by the Rev. J. Cumming*, 1823.

THE END.

STADTBIBLIOTHEK AUGSBURG

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PLATE XIII.

Fig. 1. Represents the exterior of a carbonate of lime calculus, from the urinary bladder of the Hog. V 3, p. 152.

Fig. 2. Represents the interior of the same calculus.

Fig. 3. Represents the section of a calculus, taken from the ureter of the Sturgeon, *Acipenser Huso*, Linn. These concretions were formerly termed Beluga stones. They are composed of 1 equiv of diphosphate of lime with 5 eqs. of water. R 1, p. 147.

Fig. 4. Represents the smooth polished exterior of some small carbonate of lime calculi from the urinary bladder of the Ox.

Fig. 5. Represents the exterior of three small calculi from the Ox. They are similar in composition to the preceding, but their exterior is rough and tuberculated. V 30, p. 156.

Fig. 6. Represents a small oxalate of lime calculus, from the ureter of a Hog. Q 1, p. 143.

Fig. 7. Represents the section of a urinary calculus composed of carbonate of lime, which was voided by a mare. V 11, p. 154.

Figs. 8, 9. Represent the exterior and interior of the urate of potass calculus. From the bladder of a species of Iguana. P 6, p. 141.

Figs. 10, 11. Represent the exterior and the section of the ordinary renal calculi from the Horse. They consist principally of carbonate of lime. V 4, p. 152.

Fig. 12. Exhibits the smooth shining surface which the carbonate of lime calculi from the kidney of the Ox usually possess. V 22, p. 155.

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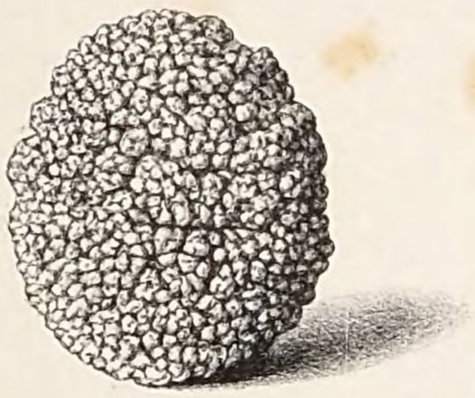

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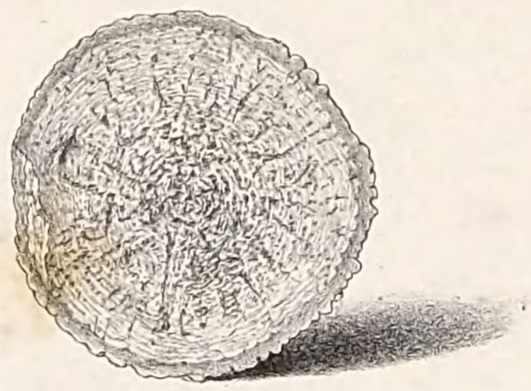

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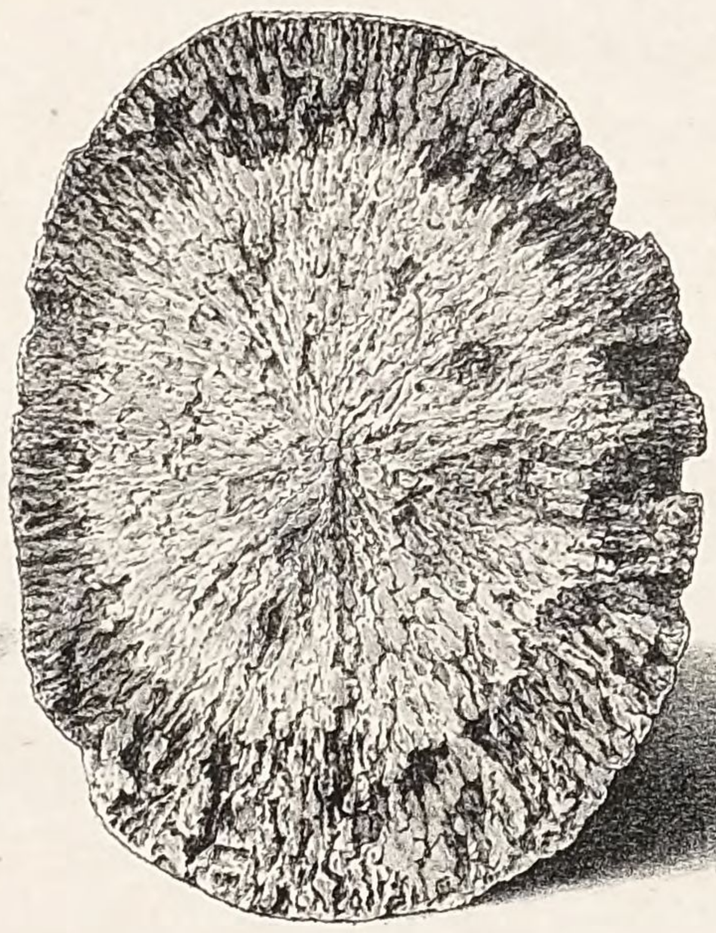

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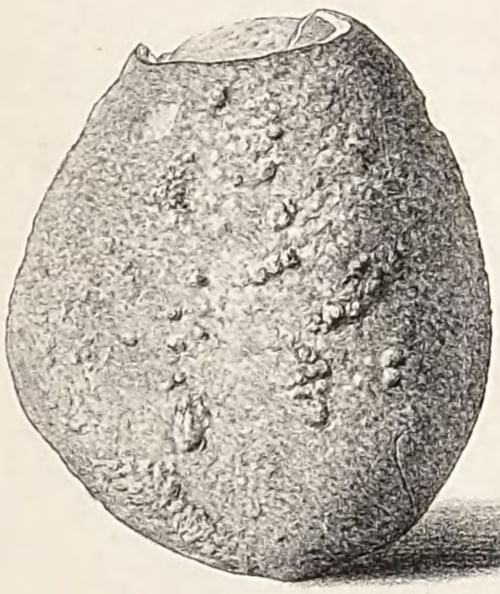

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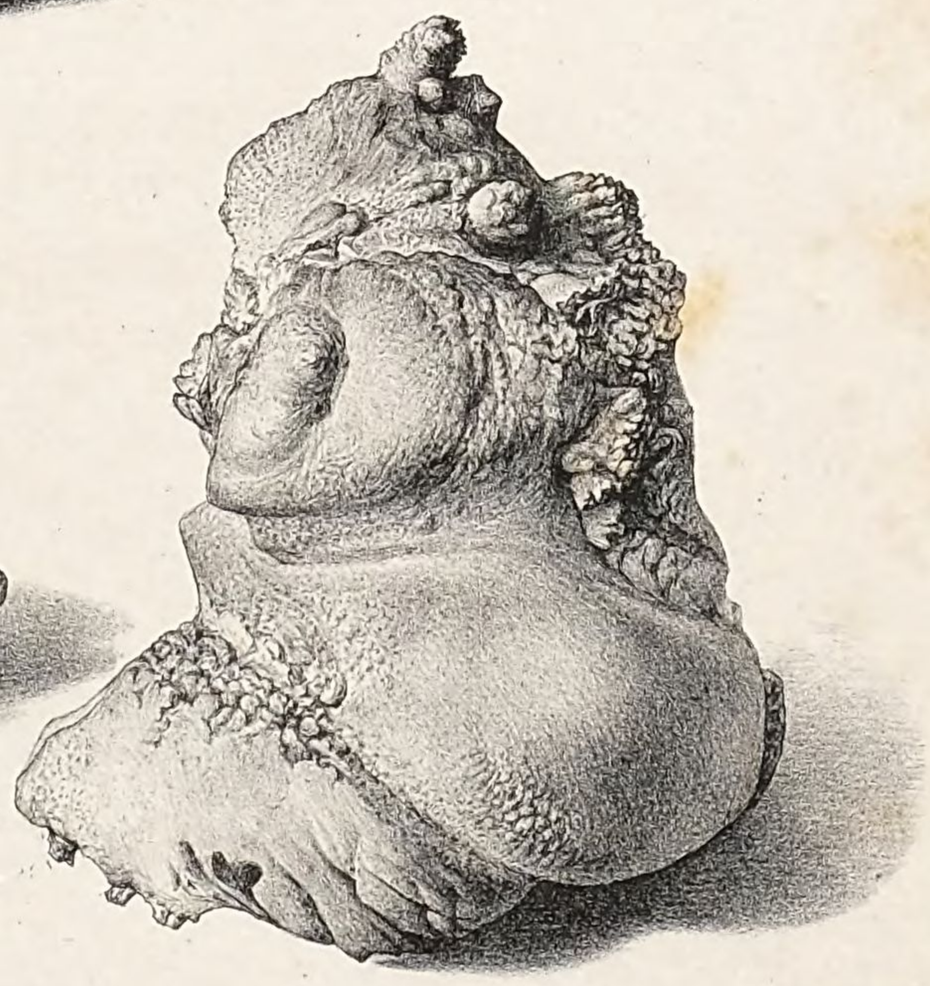

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From Nature on Zinc by Lens Aldous.

PLATE XIV.

Fig. 1. Exhibits the crystalline structure which the broken surface of the triple phosphate calculus from the alimentary canal of the Horse usually presents.

Fig. 2. Represents the section of a similar calculus divided by the saw, in which the laminated structure is most apparent. The centre of this calculus consists of large crystals of triple phosphate. § 62, p. 247.

Fig. 3. Represents the section of an intestinal concretion, consisting of diphosphate of magnesia. ℂ 2, p. 250.

Fig. 4. Represents the scaly tuberculated exterior, characteristic of diphosphate of magnesia calculi. ℂ 14, p. 251.

Fig. 5. Represents a fragment of a diphosphate of magnesia calculus, showing the reticulated deposit of phosphate of lime which is usually found between their layers.

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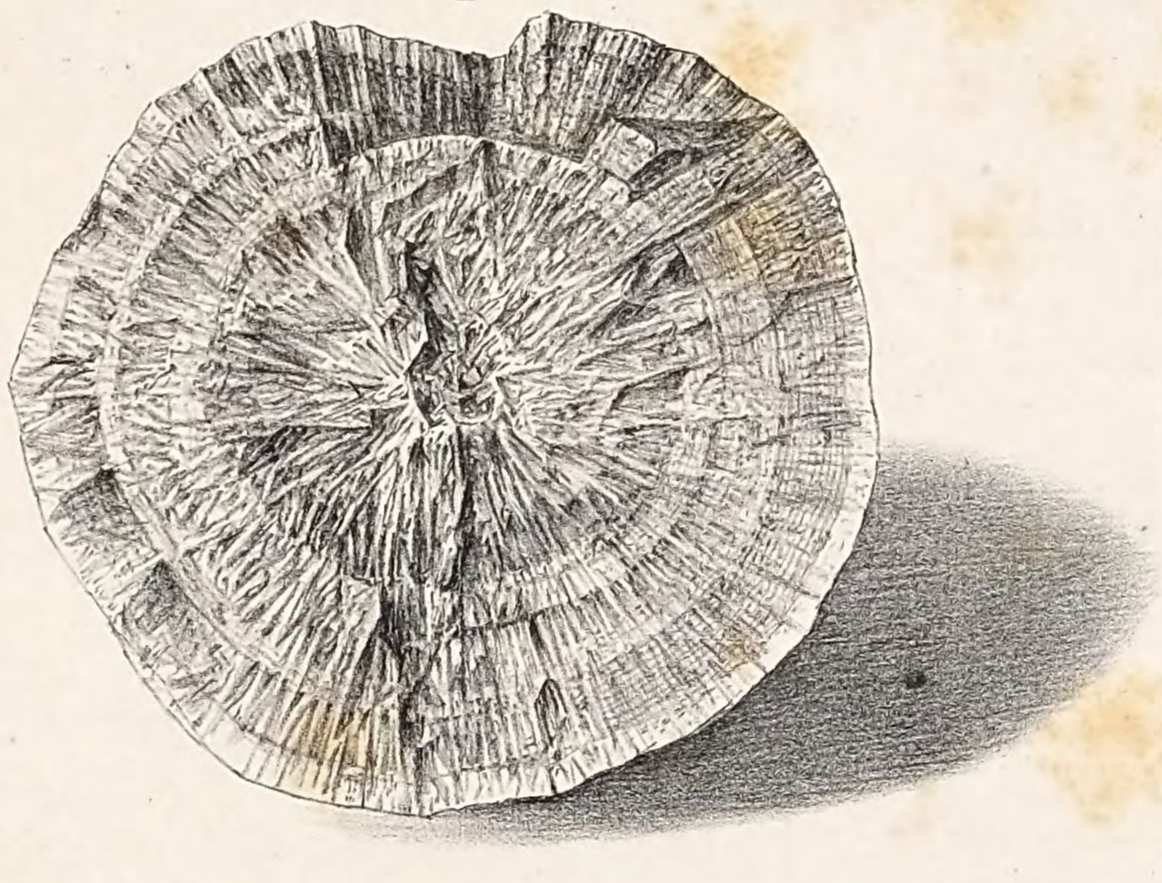

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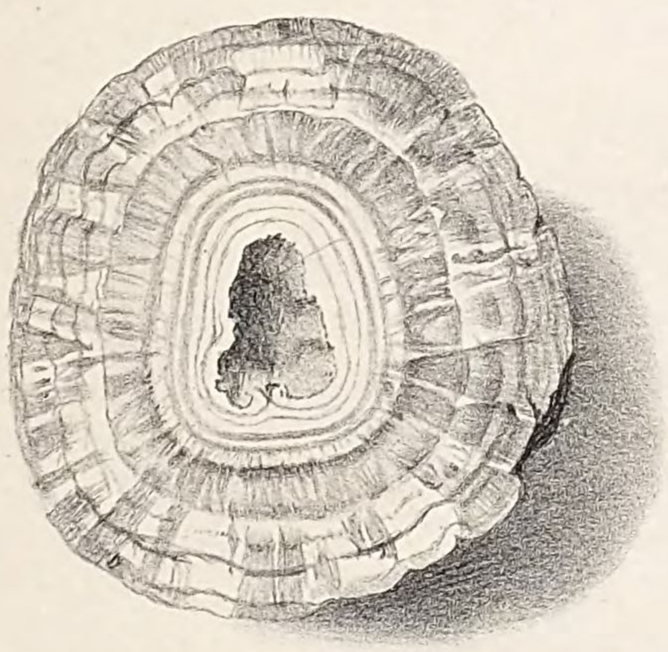

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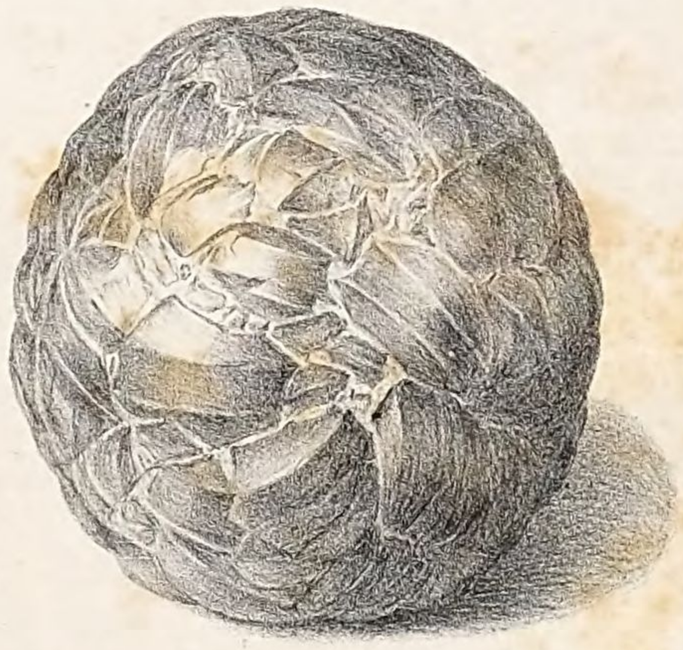

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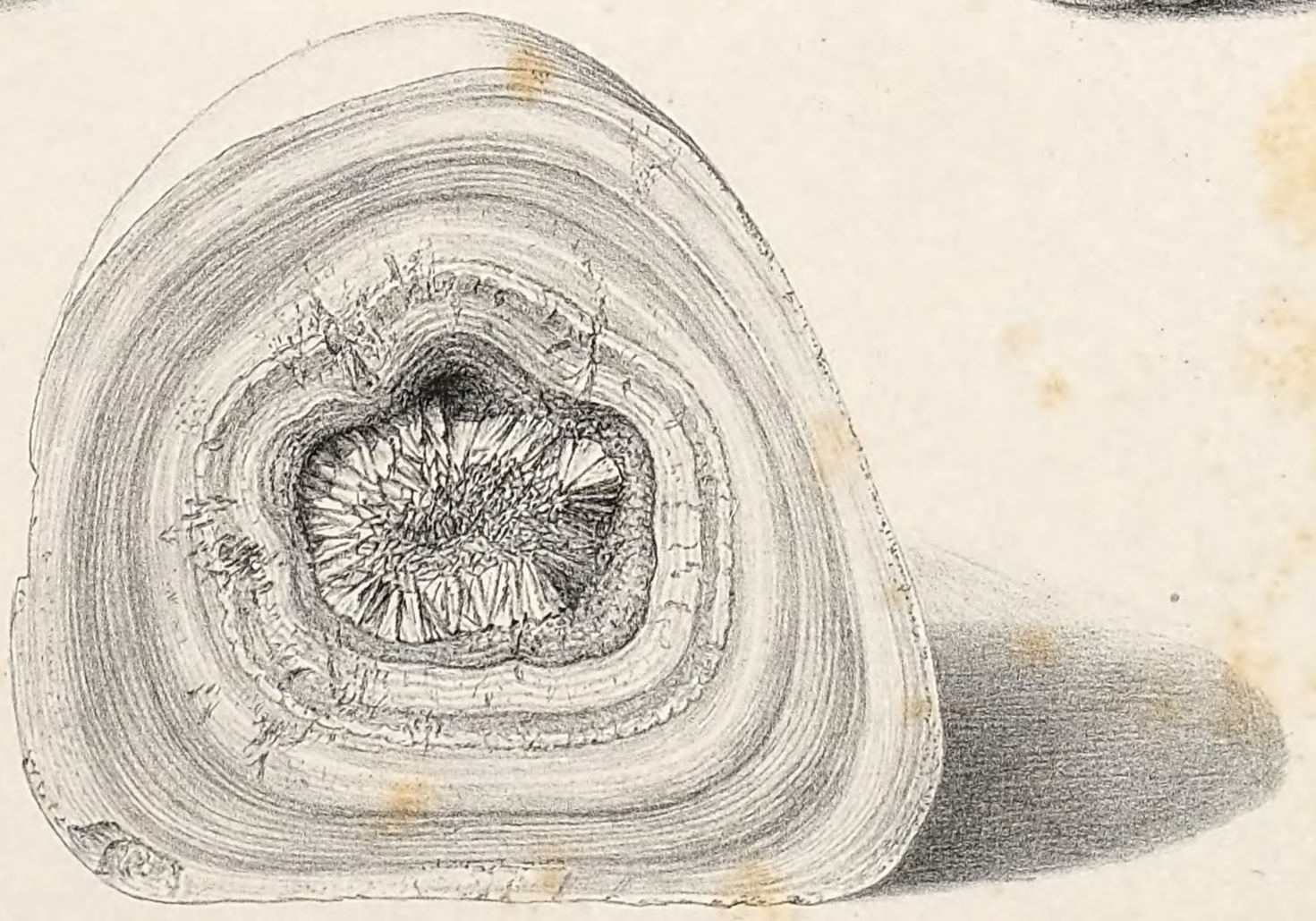

From Nature, on Zinc by Lens Aldous

PLATE XV.

Fig. 1. Represents the section of an intestinal calculus, composed of nearly pure oxalate of lime. 𝔘 4, p. 260.

Fig. 2. Exhibits the crystalline exterior of the same calculus.

Fig. 3. Represents the section of an oxalate of lime calculus, having a nucleus of vegetable fibre. 𝔘 2, p. 260.

Fig. 4. Represents the broken surface of a small diphosphate of lime calculus, showing the pseudo metallic lustre which its layers occasionally present. 𝔘 55, p. 258.

Fig. 5. Represents the section of a large diphosphate of lime calculus, which exhibits in a marked manner the laminated and radiated structure characteristic of this species of intestinal calculus. 𝔘 2, p. 253.

Fig. 6. Represents the external surface of the same calculus.

Plate.15.

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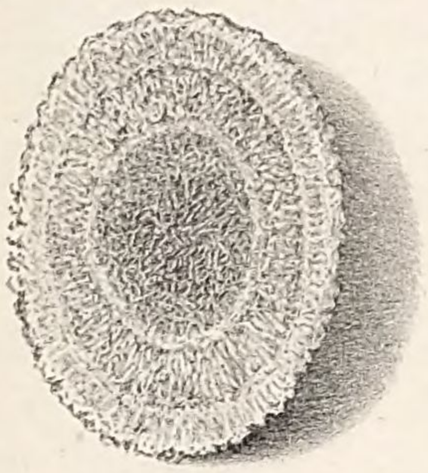

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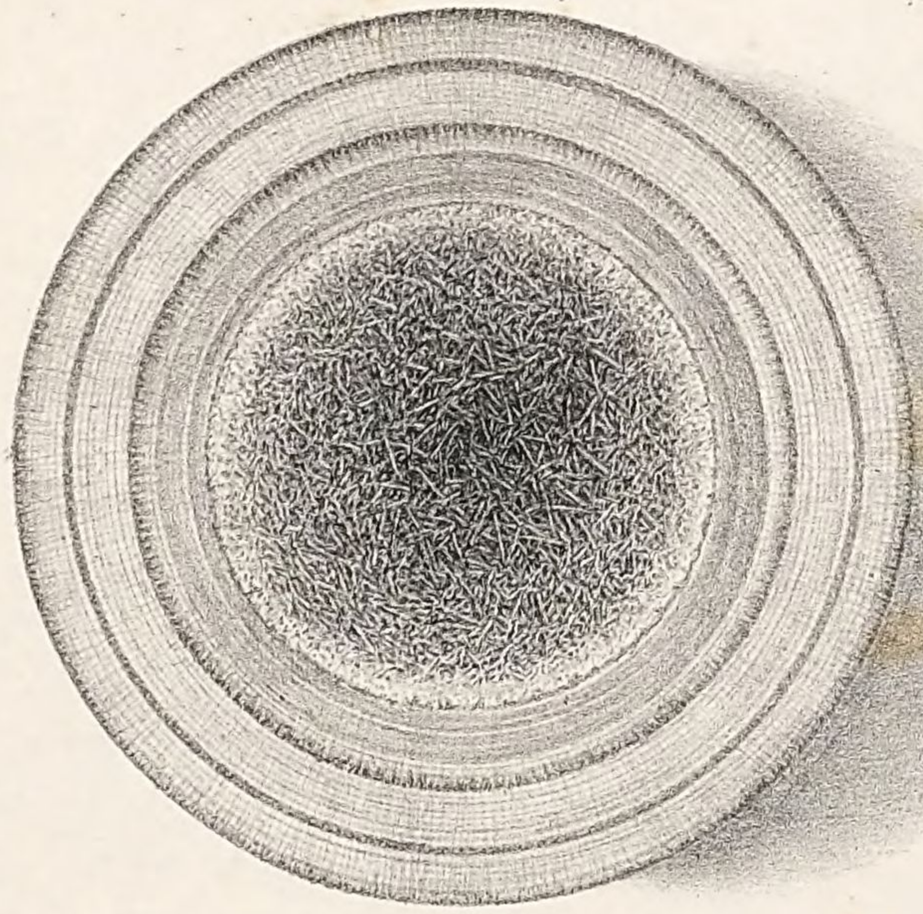

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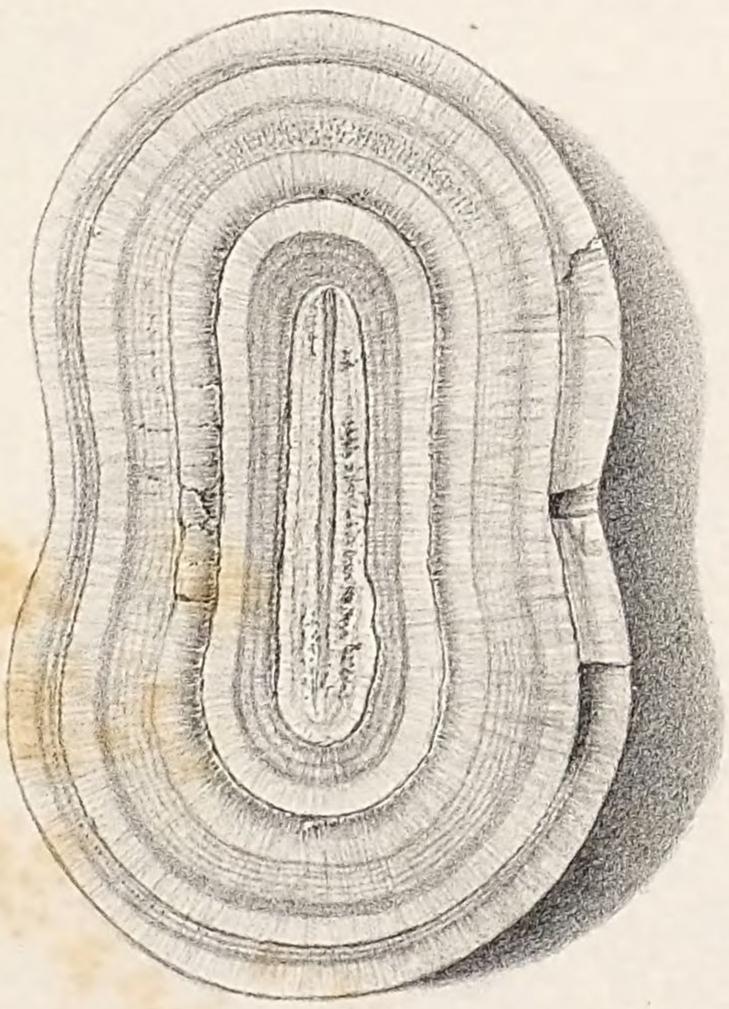

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From Nature, on Stone by Lens Aldous

PLATE XVI.

Figs. 1, 2. Represent the exterior and a section of an Oriental Bezoar, described in this Catalogue as consisting of ellagic acid. The nucleus consists of the capsule of some seed. Q 2, p. 232.

Fig. 3. Represents the *Pedra Bugia* or Ape-stone, also composed of ellagic acid, and having a piece of twig in its centre. Q 18, p. 233.

Fig. 4. Represents the half of a hair-ball, coated by a thin earthy crust. From the intestine of a Cow. G 16, p. 218.

Fig. 5. Represents the exterior of an uncoated hair-ball, from the Cow. This figure shows the regular manner in which the hairs are arranged around the long axis of the calculus, owing to the peristaltic action of the intestines. G 1, p. 217.

Fig. 6. Represents the section of an oat-hair concretion from the intestine of the human subject. *a* is an oat-seed slightly magnified, showing the small setæ on its summit, of which the oat-hair concretions are composed. *c*, *b*, *d*, *e* are highly magnified views of the setæ of the oat-seed. The diameter of the central tube of *b*, *c* is much smaller than that of *d* and *e*. From a drawing by Dr. J. W. Griffith. J 1, p. 195.

Fig. 7. Represents the ordinary appearance of the exterior of a resino-bezoardic acid calculus (*Lithofellinic acid*, Goëbel). These concretions are described in this Catalogue as consisting of a vegetable resin derived from the juices of the plants on which the goats of Persia and South America have fed. R. p, 238.

Fig. 8. Represents the section of the same calculus.

Fig. 9. Represents a fragment of a resino-bezoardic acid calculus. R 20, p. 240.

Plate 16.

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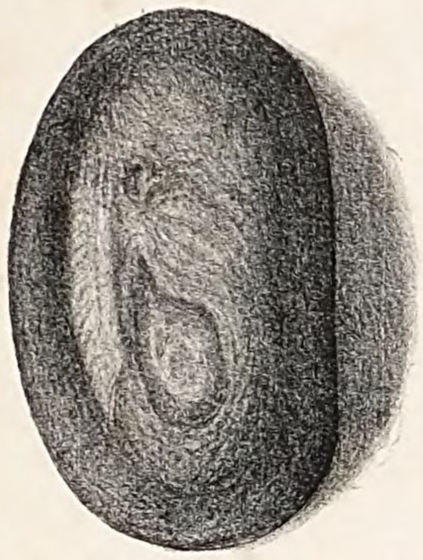

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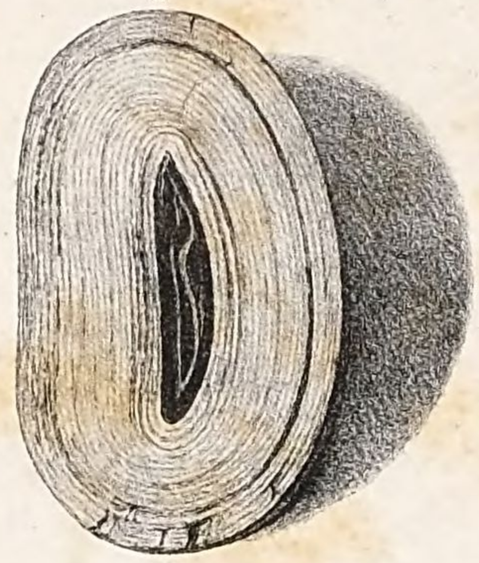

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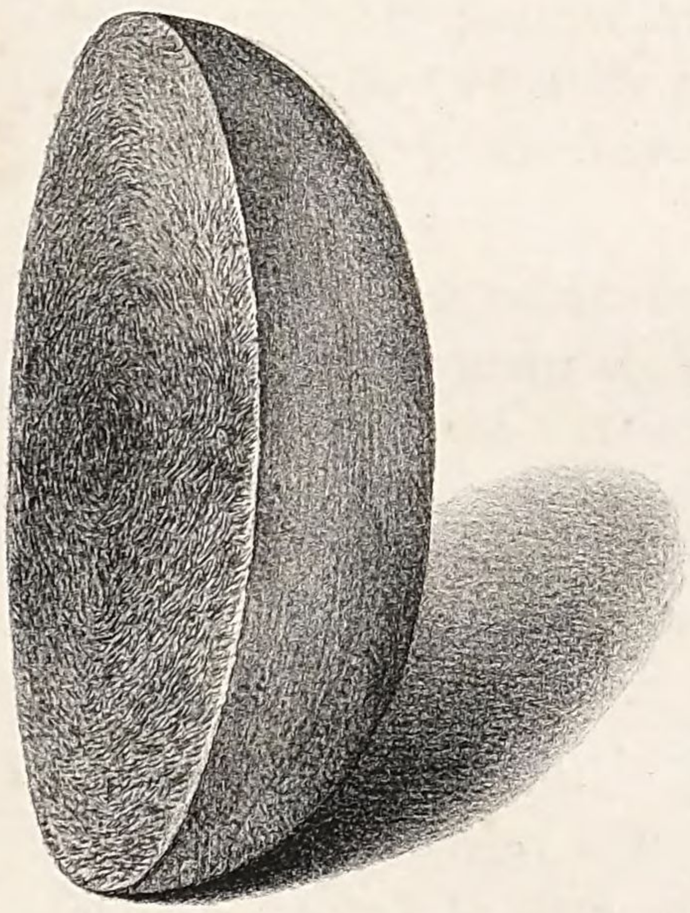

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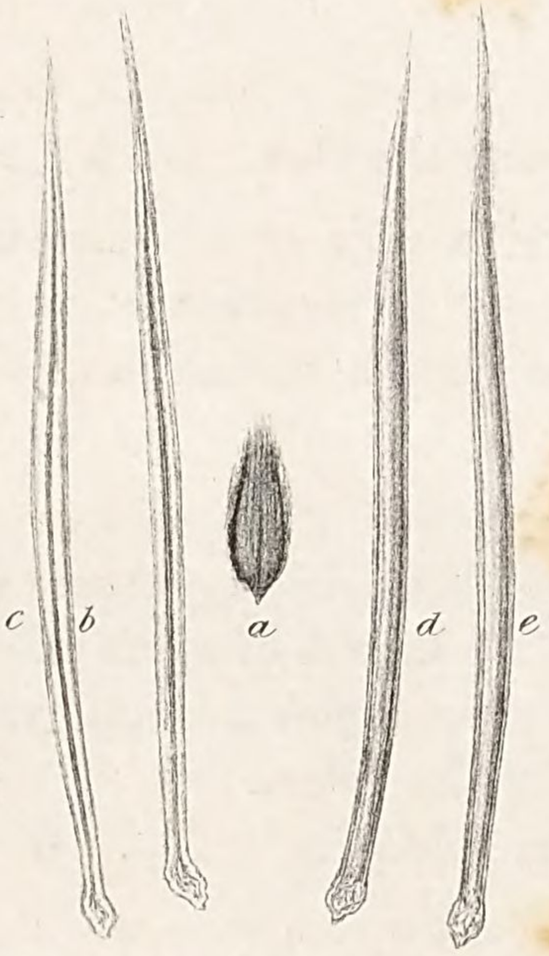

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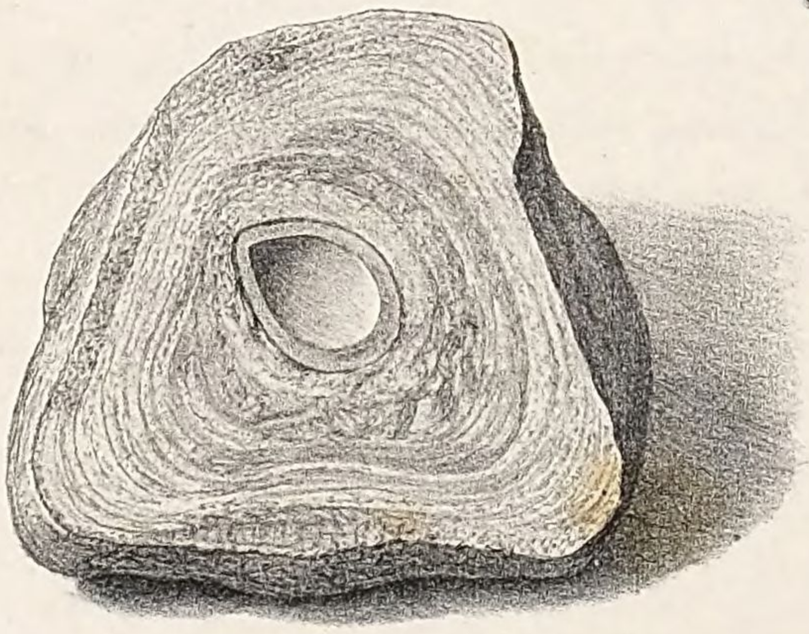

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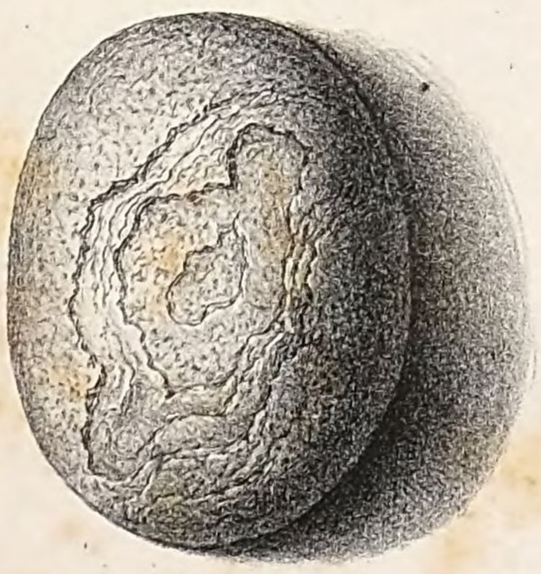

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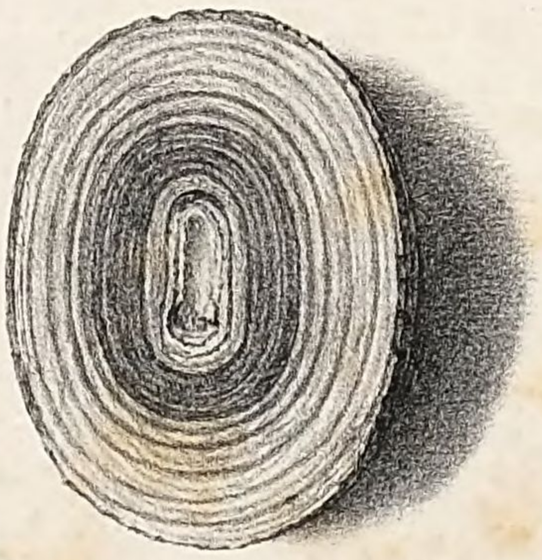


From Nature on Zinc by Lens Aldous.

PLATE XVII.

Fig. 1. Exhibits the section of the stearate of lime calculus described at page 187. From the gall-bladder.

Figs. 2, 3, 4, 5. Are representations of the ordinary biliary calculi from Man, composed of cholesterine, mixed with the colouring matter of the bile.

Fig. 6. Represents the section of a triple phosphate calculus from the urinary bladder of a Whale. S 5, p. 148.

Fig. 7. Represents a salivary concretion from the sublingual duct of the human subject. 𝔊 4, p. 191.

Fig. 8. Represents the half of a large biliary calculus, voided per anum. Its centre consists of pure cholesterine, its outer layers of cholesterine and the colouring matter of the bile. 𝔄 4, p. 168.

Figs. 9, 10, 11. Are highly magnified views of the vegetable hairs, of which the concretions described at pages 224, 225 are principally composed.

Fig. 12. Represents a group of small six-sided plates of resino-bezoardic acid, produced by the cooling of the fused resin.

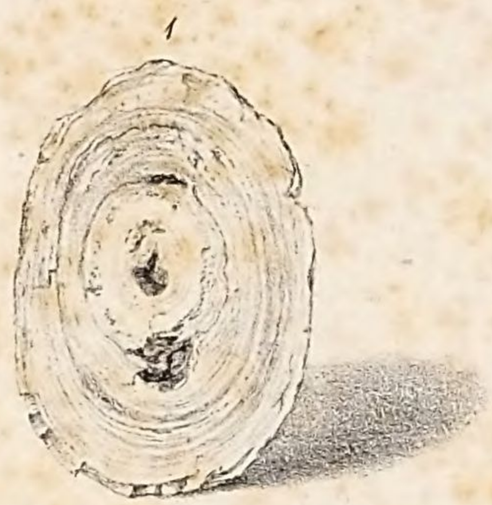
Fig. 13. Represents a section of a carbonate of lime calculus from the gall-bladder. 𝔇 1, p. 190.

Fig. 14. Represents the biliary calculi described at page 183. 𝔅 β 1 and 2.

Figs. 15, 16, 17. Represent three different forms of biliary calculi from the Ox. Colouring matter of the bile. 𝔐 2, 3, pp. 202, 203.

STADTBIBLIOTHEK AUGSBURG

Plate 17.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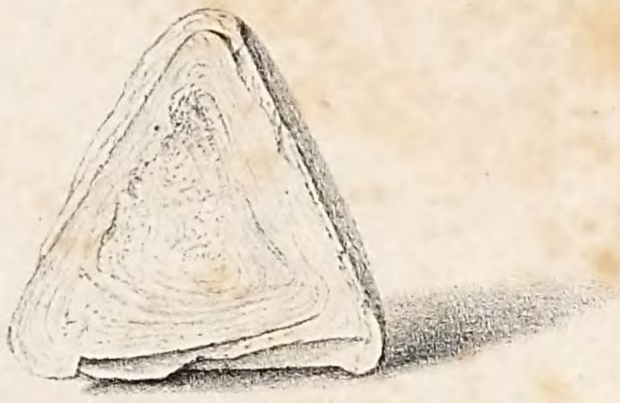
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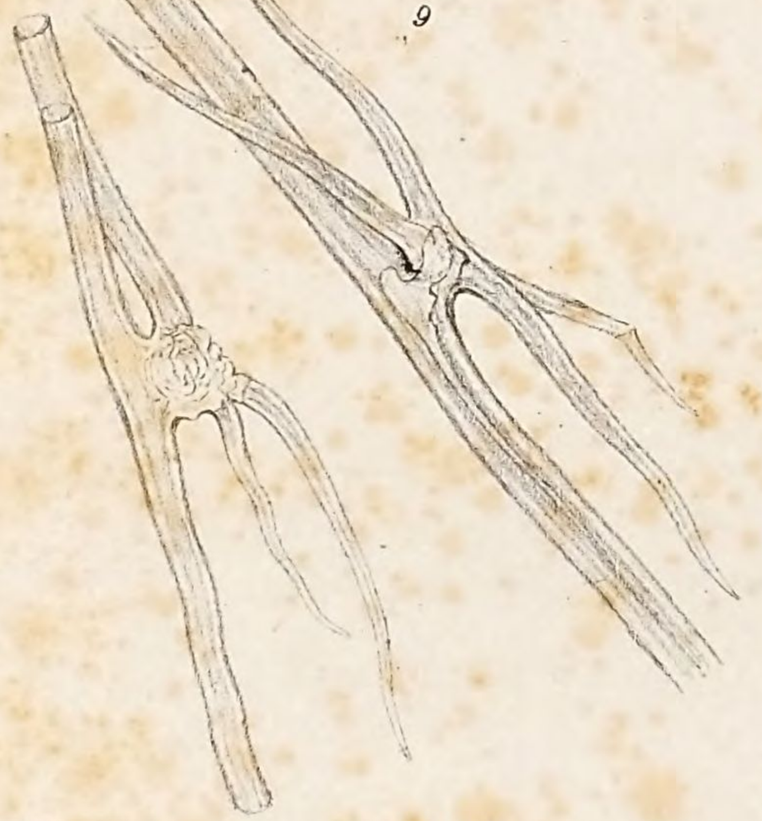
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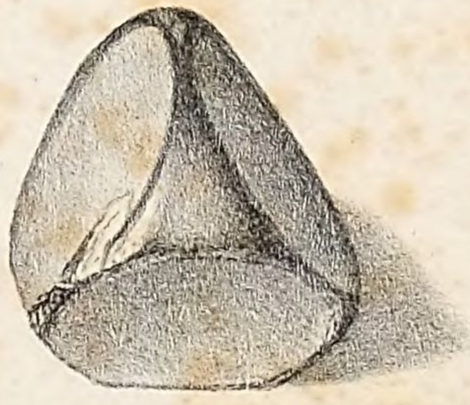
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From Nature on Zinc by Lens Aldous.

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Med.

Catalogue

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A Descriptive and Illustrated Catalogue of the Calculi and other Animal Concretions contained in the Museum of the Royal College of Surgeons in London
Bd.: 2/3

London (1845)

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